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Electrical Review

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CHARLES W. PRICE, - - - - - EDITOR.
STEPHEN L COLES, - - - - MANAGING EDITOR.
CHARLES T. CHILD, - - TECHNICAL EDITOR.
STEPHEN H. GODDARD, - - ADVERTISING MANAGER.
RUSSELL HOWLAND, ASS'T ADVERTISING MANAGER.

REGISTERED CABLE ADDRESS:
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TELEPHONE CALL, 1546 "CORTLANDT."

WESTERN OFFICE:
FRANK E. COLBERT, - REPRESENTATIVE,
1612-1613 Marquette Building, Chicago

WASHINGTON OFFICE:
GEO. C. MAYNARD, - - REPRESENTATIVE,
Room 102. Washington Loan and Trust Building, WASHINGTON, D. C.

LONDON OFFICE:
HENRY W HALL, - REPRESENTATIVE,
42 Old Broad Street. LONDON, E. C.
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SELLING THE BY-PRODUCT.

The paper on "Hot Water Heating from a Central Station," by Mr. H. T. Yaryan, on another page, is one that should be intensely interesting to all electric light station men. In these columns attention has frequently been called to the fact that the only by-product of a lighting or railway power station is heat, and that there is a ready market for this during seven months of the year and those the months when most of it is available for sale. The method suggested by the article mentioned is one that commends itself for simplicity and ease of operation. It is not easy, however, to admit all that Mr. Yaryan says in defense of his system as compared with exhaust steam heating methods. The latter have had a sufficient trial to demonstrate their great usefulness and value, and while admitting the great excellence of the hot water system it seems unnecessary to enter into a discussion of the relative merits of the two, when either would be a means of turning many a non-productive station today into a paying enterprise.

In another place in this issue of the ELECTRICAL REVIEW is published a very interesting plan showing the relative areas of various expositions as compared with that of the Pan-American Exposition, which is to be held at Buffalo, N. Y., in 1901. A glance at the diagram will indicate that the arrangement and extent of the principal areas of this exposition lend themselves unusually well to brilliant and original decorative effects. The ELECTRICAL REVIEW is informed that the electric lighting and electric fountain display at the Pan-American Exposition will be on a grander, more original and more satisfactory scale than has ever been attempted. The plan adopted involves consideration of the buildings, the areas and the horticultural effects as well as the water effects. We are assured that the electrical features of the Pan-American Exposition will be eminently satisfactory, not only to the visiting public but also to electrical engineers and landscape artists.

All high-class and high priced cafés and restaurants are provided with electric fans to keep their guests cool in warm weather. But few of them seem to have fans in the serving-rooms and kitchens. Consequently, the cool and comfortable diner has his temperature raised and his appetite spoiled by the attentions of red-faced waiters dripping with perspiration. Here is a good chance for the electric fan man.

The electrical section of the Paris Exposition seems to be full of troubles. Last week the rain leaked in and did considerable damage. Shortly after this somebody added a handful of sand to the lubricant of the engine driving the lights on the main entrance. Then fire broke out and damaged the electrical apparatus for the illumination of the fountains of the Chateau d'Eau. It will be recalled that seven years ago, when electrical engineering was not so far advanced as it is to-day, there were no fires in the electrical apparatus at Chicago.

Can not some one invent an open car in which it will be impossible for passengers to stand in the narrow spaces between seats, to the annoyance, discomfort and offense of those sitting? In New York passengers are not allowed to stand on the foot-boards of open cars, and when the car is full they crowd in, trampling the feet of the sitting passengers and standing in a proximity which is always unpleasant and not infrequently repulsive. Of course, people will patiently suffer all this until something is done for their relief. Why not a car in which this standing is impossible?—and then for a public-spirited and philanthropic railway company to operate it.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

During the fifteen years that have comprised its history, the National Electric Light Association has steadily grown in power and importance, in influence as in accomplishment, without once having gone backward in its course.

When the association was first suggested in the editorial columns of the ELECTRICAL REVIEW, in December, 1884, it was conceived that its principal interest would be in the exchange of experiences by members. It was thought then that at the gatherings of the body the members would tell one another what they found out in their then almost tentative experiences with a new business. For only a short while was the scope of the association limited to this interesting and useful exchange. The body soon found that it had influence sufficient to command respect and that it might use this influence for the benefit of the industry at large. The feature of experience exchange was never lost sight of, however, but to it was added another even more valuable—the reading of papers on subjects connected with the technology of electric lighting.

These papers have been of curiously diverse type. Many of them have dealt with the purely business side of the industry, while others have been electrical papers of high importance. Indeed, many papers of the greatest distinction are presented at these conventions in preference to making their appearance before scientific societies or by publication. The reason for this is evident; it is because the membership of the association comprises the working engineers of the electrical field—men best competent to judge of the value of a new idea or to give expression in material form to a new suggestion.

Clustering around the conventions of the association, a very large number of subsidiary interests have made it convenient to be represented at the sessions. The result is that the meetings are seasons of reunion for the members of the electric lighting and electrical fraternity, whether or not they be members, and that the attendance upon the conventions is generally several times greater than the total membership of the association.

The meeting this year, in Chicago, promises to be the best in the history of the association. On account of its central position and easy access Chicago will attract a large number of delegates and visitors from the thriving and prosperous middle region of the country of which it is the metropolis. The convention will be excellently housed and will have an adequate and comfortable meeting hall in the Auditorium Hotel. The programme is of unusual excellence and interest, and the names of the authors presenting papers are such as to command in advance a great degree of respect.

The association is an institution which deserves the heartiest support and assistance on the part of all interested in the electrical industry. Its meeting this year is sure to be an occasion of both pleasure and profit to those fortunate enough to be in attendance upon it.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The American Institute of Electrical Engineers is now sixteen years old, and during its lifetime it has been of enormous importance to electrical engineering, to the advancement of science, and to the great industries dependent upon electricity. It is the representative body of American electricians, occupying in the United States much the same position as that held by the Institution of Electrical Engineers, in Great Britain, or the Société Internationale des Electriciens, in France. Membership in it is restricted to those who have done some work of importance in electricity, although any one connected with the electrical profession is eligible as an associate member.

The general meetings of the Institute, which take place annually, are occasions of the deepest interest. Papers of high class are always presented and the meeting which is now being held in Philadelphia forms no exception to this rule. The first meeting of the Institute for the reading and discussion of papers was held in Philadelphia at the time of the Electrical Exposition, in 1884.

In 1886 the practice of holding monthly meetings in New York was inaugurated. The first was held on June 8, in the Mills Building, in Broad street, New York, and aroused an interest that has never ceased.

In 1894 the western members made arrangements to hold meetings in Chicago simultaneously with those in New York, the same papers being read in both cities. General meetings have been held every year since the Institute was formed. They generally last from three to four days, and are especially intended for the benefit of members unable to attend regularly the meetings at New York and Chicago.

In 1887 the monthly publication of the *Transactions* of the Institute was begun, a practice which other engineering societies later adopted. In 1888 executive offices were established in New York and a permanent secretary was employed to devote his whole time to the work.

Since then the Institute has grown and prospered. It has achieved prominent recognition as one of the foremost engineering societies of the world, and while the importance and value of its work are hard to estimate at their just worth, they have been simply enormous. It has, to-day, three hundred and sixty-eight members and seven hundred and seventy-two associate members, who comprise the great majority of the active workers in the field of electrical engineering.

The actual work on the rapid transit subway, in New York city, has at last begun. There have been, so far, three edifying public spectacles in connection with the beginning of this enterprise. The Mayor dug a silk hat-full of earth out of the City Hall plaza last month and the public authorities commemorated the act by placing a memorial tablet upon, and a *chevaux-de-frise* of park benches around, the sacred spot. A few days later the chief engineer of the enterprise pried up a cobble-stone in Bleecker street, where a large sewer is to be moved. On May 14 actual work was begun in the Washington Heights district, but not until Corporation Counsel Whalen dug up a loving cup-full of earth. Then the pickaxe passed into the hands of the stalwart laborers who will finish the job in the next few years.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

ITS HISTORY, ITS WORK, ITS PERSONNEL, ITS ACCOMPLISHMENTS AND ITS FUTURE.

Electric lighting, as a business, was first prominently practiced in the United States during the early '80's. When companies formed to exploit the lighting business in the various cities and towns, each had its own problems to solve, each had its own difficulties and each made its own experiments in adapting the untried agent, electricity, to the commercial purposes of making light which could be sold for an adequate return in money.

As might readily be conceived, the problems encountered, while varying somewhat in detail, were practically the same in all cities. Unlike other businesses, there was practically no competition in electric lighting. In each town, at that time; or, in the larger cities, in each district, there was an electric lighting company limited by the nature of things to its own immediate neighborhood as a sphere of operation.

It soon came to be seen that cooperation of an effectual sort was possible and that each company could learn something from the experience of all the others which would be beneficial to it and, at the same time, in no degree hurtful to those from whom the information was gained. It was in view of this state of things that the ELECTRICAL REVIEW, in December, 1884, printed an editorial, which said in part:

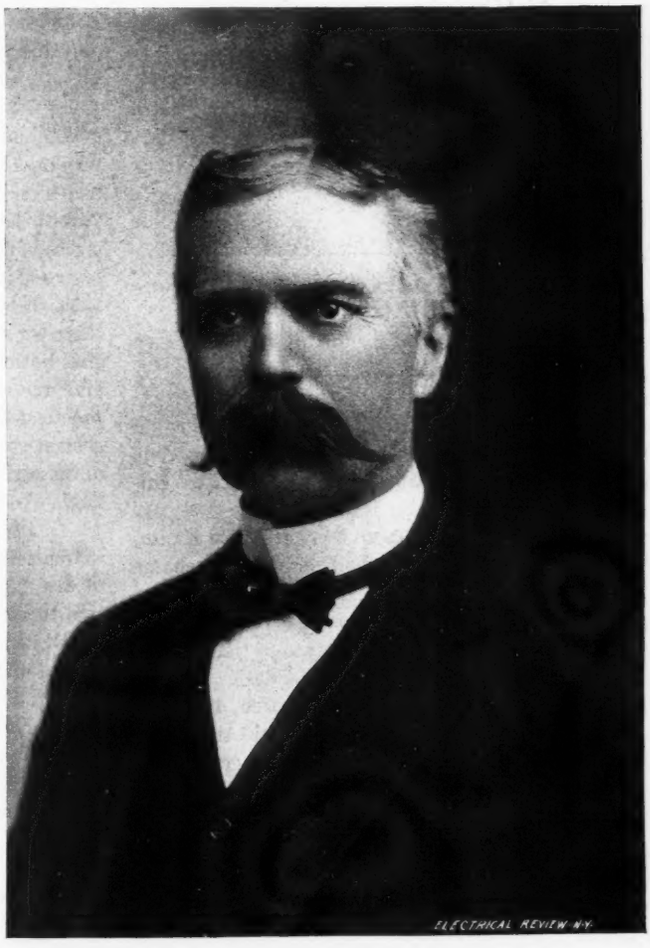
"The art is new, and no manager of an electric light company can anywhere be found who is not ready to admit that he has much to learn. It is not so much that it is desirable to discuss and compare existing systems—comparisons are always odious—but that it is important for men who are carrying on the lighting business in widely scattered localities to come together and render mutual help by giving one another the benefit of their practical experience."

This was the real beginning of the movement which resulted in the formation of the National Electric Light Association. In February, 1885, pursuant to the suggestions contained in the remarks quoted above, a number of electric light men met in a parlor in the Grand Pacific Hotel, Chicago, and were called to order by Mr. William A. Hovey, then one of the editorial staff of the ELECTRICAL REVIEW.

It is interesting to look back to the first day of the association's life and see that its purpose was understood then as well as it is now. Mr. George S. Bowen, in taking the chair, as temporary chairman at the first meeting, said:

"I give you the most cordial welcome on the part of the people of Chicago for coming so great a distance in order to discuss our troubles and trials, and also to consider our future hopes on the subject of electric lighting."

This is just what the National Electric Light Association has been doing ever since, discussing its troubles and trials and airing its hopes. But with each succeeding year the troubles and trials have grown smaller and the hopes have grown brighter.



GEN. SAMUEL T. CARNES, OF MEMPHIS, TENN., PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Only about 85 gentlemen were present at the Chicago meeting. The convention remained in session for two days and the greatest interest was displayed by those present and by electric light people all over the country when the news of the successful meeting and of the matters of high importance to the electrical industry that were presented and discussed there was disseminated. The officers elected for the first year were as follows: J. F. Morrison, of Baltimore, president; H. M. Cleveland, of Hartford; J. H. Yarborough, of Nashville, and E. R. Weeks, of Kansas City, vice-presidents; W. A. Hovey, New York, secretary; George S. Bowen, Chicago; W. Hochhausen, New York; G. Donaldson, St. Paul; Frank Ridlon, Boston; John R. Fletcher, Dayton, and James O'Conner, New Orleans, executive committee.

The next meeting was held in New York in August of the same year, the attendance on that occasion being larger and the success of the new association being well established by the enthusiasm which was created. The third meeting, or second annual convention, was held at the Carrollton Hotel, in Baltimore, in February, 1886. By this time the association had gotten on a regular basis, had mapped out its plan of operations and had begun to have presented before it the series of superb papers which have made it and its meetings of such vital interest and value to the electric lighting interests of the United States ever since. The practice of holding two meetings a year was discontinued after a short period and one session was held annually, the association meeting in various cities and places. Three years ago it was decided that thereafter the meetings would be held alternately in New York and Chicago, in the Spring, this being the most convenient season for the members to be absent from their business and the pleasantest for traveling. By alternately meeting in these two cities, which represent the greatest aggregations of population in the United States, the association brings itself most closely to its members.

The presiding officers of the association have all been men of force and character, and representative men in the industry. It is a pleasant fact that they are to-day all alive and in good health. Some idea of the class of men prominent in the association may be gained from the short biographies of its various presidents, which are presented below:

OFFICERS OF THE ASSOCIATION.

James F. Morrison, first president of the National Electric Light Association was connected with the telegraph business from its earliest years. He first took service with the Baltimore & Ohio and the old American Telegraph Company, and in 1868, was transferred to the New York office of Western Union Telegraph Company, then at the corner of Liberty street and Broadway. In 1869, he became associated with James M. Ashley and Franklin L. Pope, in exploiting the Edison Gold and Stock Printing Telegraph. Subsequently, he took service with the Western Union in various cities through the country. He returned to Baltimore in 1871 to accept the management of the Baltimore office. In 1874, he built the fire alarm telegraph for Baltimore city. In 1877, he built telephone lines connecting the penal institutions of the State of Maryland with Baltimore city.

In 1878, he built the first long-distance telephone line ever constructed. It was for the use of the Chesapeake & Ohio Canal Company, between Georgetown and Cumberland, about 150 miles long. It was equipped with Edison telephones (carbon button transmitter), the Bell Company, at that time, not having fully exploited the Blake transmitter.

He was the pioneer in the electric lighting business, having built the first *new* station ever constructed—although a temporary station had been constructed in New York on Twenty-third street, and experimental lines for arc lighting placed on Broadway by the New York Brush Company.

Since then, he has been interested in a number of electric lighting companies in various parts of the country, and has organized and brought into successful operation the Brush Electric, Maryland Electric, Edison Electric and Northern Electric Companies, of Baltimore, Md., all of which are to-day consolidated under one management.

Samuel A. Duncan, second president of the National Electric Light Association, was an old-time telegraph operator before becoming identified with the electric lighting industry. His operations in the field of central station practice have been mostly confined to the territory around Pittsburgh and Allegheny, where he was general manager of the Allegheny County Light Company. During the last few years Mr. Duncan severed his connection with the lighting industry and has returned to the telegraph field. He is now division

JAMES F. MORRISON, OF BALTIMORE, FIRST PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

superintendent for the Postal Telegraph Cable Company, at Atlanta, Ga.

Edwin R. Weeks, third president of the National Electric Light Association, became identified with the electric lighting business in 1883 when he was appointed first superintendent of the Kansas City Electric Light Company, in charge of the first central station operated under the Thomson-Houston patents. The rapidly increasing importance of the business soon required a division of duties, and the office of manager was created, to which Mr. Weeks was promoted, and still later, he was elected general manager of the Kansas City Company. He also held the same position in the Edison, Sperry and American Companies of Kansas city.

Mr. Weeks brought the business to so high an earning capacity that good dividends were paid when most of the early electric light companies all over the country were proving poor investments for their owners. This earning capacity was held

SAMUEL A. DUNCAN, Second President.

EDWIN R. WEEKS, Third President.

in the face of the keenest competition—both gas and electric—standard all night arc lamps being run at two dollars per lamp per month, and a good grade of gas being served at fifty cents per thousand, together with *free* service, Welsbachs, and gas stoves. Moreover, this cut-throat competition occurred during the time of the recent great financial depression. The good showing thus made enabled Mr. Weeks to negotiate successfully with the Armour interests for a sale of his companies at most favorable figures, and retained for him the position of general manager in connection with the vice-presidency when the transfer was made in January, 1900.

Marsden J. Perry, fourth president of the National Electric Light Association, is a gentleman prominent in the business and financial affairs of New England, especially in Providence, R. I., where he resides. Mr. Perry is vice-president and general manager of the Narragansett Electric Lighting Company, of Providence, in which he has been interested for many years. He is a power in local banking circles, and, about six years ago, acted as receiver for the New England Railroad, with the Hon. T. C. Platt. Mr. Perry takes an active interest in the affairs of the National Electric Light Association and understands and appreciates from a practical standpoint the importance to the central station interests of the country of an association like the National Electric Light Association.

Charles R. Huntley, the fifth president of the National Electric Light Association, began his electrical career with the Brush Electric Light Company, of Buffalo, N. Y., on January 1, 1888, being then appointed as the secretary of the company. Shortly afterward he was made manager of the company, and continued in this position until August 1, 1892, when all of the electric interests of the city were consolidated and he was made general manager of what is known as the Buffalo General Electric Company. Mr. Huntley's career in the electrical field has been like that of the "happy nation which has no history." He has gone ahead steadily since his connection with the electrical industry 12 years ago; always in the same city and same company, but constantly advancing as the business has grown and prospered under his hands.

James I. Ayer, sixth president of the National Electric Light Association, entered electrical work in the early part of 1884, after having had several years experience in civil engineering, followed by a period of six years in mercantile business. His first service in the electrical field was with the Jenny Electric Company, of Fort Wayne, Ind., then just organized, in which he acted as general

sales agent. Mr. Ayer remained in that relation until 1889, when he designed and built the plant of the Municipal Electric Lighting and Power Company, at St. Louis, Mo. He continued in charge of this plant as general manager until 1894. In 1894 and the succeeding year he did much work in the early development and exploitation of the enclosed arc lamp

MARSDEN J. PERRY
4th President.

CHARLES R. HUNTLEY
5th President.

JAMES I. AYER,
6th President.

moving to Boston, in 1896. Mr. Ayer has since been identified with electric heating interests, conducting the business of the American Electric Heating Corporation, now known as the Heating Department of the Simplex Electrical Company, as general manager.

Edward Ambler Armstrong, seventh president of the National Electric Light Association, has been prominently identified for many years with the central station interests of Camden, N. J., and elsewhere in the state of New Jersey. Judge Armstrong has always taken a prominent part in the deliberations of the National Electric Light Association, having held offices as first vice-president and as chairman of various important committees, besides holding the presidency. He was born at Woodstown, Salem County, N. J., and in 1880 was admitted to the bar. Judge Armstrong was elected to the New Jersey Assembly from the first district of Camden County, in 1883, and upon his reelection, in 1884, was made Speaker of the House. At this time he was but 26 years of age and is the youngest man who ever occupied that important position. He was elected for a third time in 1885 and was also reelected speaker. He became president of the Camden Lighting and Heating Company in 1889, and in 1892 was made president of the Board of Public Works and a director and solicitor for the Camden Electric Railroad Company.

M. J. Francisco, eighth president of the National Electric Light Association, started in the electrical business in 1885 and in 1888 was elected president and general manager of the Rutland, Vt., Electric Light Company and reconstructed and enlarged the entire plant. He was reelected each year until the consolidation in 1897, at which time he was elected secretary and managing director of the consolidated company. In 1888, he became a member of the National Electric Light Association, and was made a member of the executive committee of that body at Kansas City in 1890; was elected second vice-president at Providence in 1891; first vice-president at St. Louis in 1893, and president at Washington in 1894. He became a member of the American Institute of Electrical Engineers in 1890. Mr. Francisco published his first work opposing municipal ownership of electrical plants in 1890; the second in 1891; the third in 1893; the fourth in 1895; the fifth in 1898, and is now engaged upon the sixth book which will be published in 1900.

C. H. Wilmerding, ninth president of the National Electric Light Association, made his first connection with electrical matters early in 1888, when he came to Chicago from New York, in the interests

E. A. ARMSTRONG
7th President.

M. J. FRANCISCO,
8th President.

C. H. WILMERDING,
9th President.

of the Electrical Accumulator Company. For nine years previous to this he had been practicing civil engineering, the profession he had studied at the Sheffield School, Yale, in the class of 1879. In the Fall of '88 he gave up the storage battery business to accept the position of superintendent of the Chicago Arc Light and Power Company. Later he was made general manager of this company and served in that capacity until the consolidation of the arc light property with that of the Chicago Edison Company in the Spring of 1893. The early portion of this period was marked by a struggle with the problem of undergrounding high-tension wires in which the Arc Light and Power Company was a pioneer. After the consolidation Mr. Wilmerding became general superintendent of the new company, and occupied that office until the Summer of 1897. He retired from the Edison Company at that time and opened an office in Chicago as consulting engineer.

Frederic Nicholls, the tenth president of the National Electric Light Association, began his commercial connection with electricity December 27, 1888. At that time, the city of Toronto had a population of nearly 200,000 people, but had no incandescent electric light plant. Mr. Nicholls organized the Incandescent Electric Light Company, of which he was active manager for some years. This was the first company in Canada to adopt underground distribution. Some years later, the Incandescent Electric Light Company was amalgamated with the Toronto Electric Light Company, and Mr. Nicholls remained the director of the united concerns. While actively engaged in the management of the Electric Light Company, he organized the Toronto Construction and Electrical Supply Company, which was subsequently merged in the Canadian General Electric Company, of which Mr. Nicholls is now vice-president and managing director. The other positions which Mr. Nicholls at present holds in electric companies are as follows: President, Brantford Street Railway Company, Brantford, Ont.; secretary, London Electric Company, London, Ont.; vice-president, Sao Paulo Tramway, Light and Power Company, Sao Paulo, Brazil; director, Havana Electric Railway Company, Havana, Cuba; president, Woods Motor Vehicle Company, Chicago, Ill.; director, Storage Power Company, New York city.

Samuel Insull, eleventh president of the National Electric Light Association, had his first electrical experience in the telephone business in England. In 1879, he went into the service of Colonel Gournaud, then Mr. Edison's representative in England, and in various capacities had more or less to do with the old Edison telephone business before it was consolidated with the Bell interests. During this period,

FREDERIC NICHOLLS
10th President.

SAMUEL INSULL,
11th President.

ALDEN M. YOUNG,
12th President.

Mr. Insull met Mr. E. H. Johnson, and through him obtained early in 1881, an appointment as private secretary to Mr. Edison. On March 1, 1881, he arrived in the United States, and entered upon his duties in that capacity, just a week or two after the Edison Electric Light Company opened its offices at 65 Fifth avenue in New York.

Soon after this, Mr. Edison started the Edison machine works in Goerck street, New York, the Electric Tube Company and the Edison Lamp Company, at Harrison, N. J. He controlled all three corporations, and Mr. Insull was made secre-

(Concluded on page 540.)

THE BOSTON ELECTRIC LIGHT COMPANY'S CENTRAL STATION.

A HIGHLY MODERN STEAM DRIVEN PLANT DISTRIBUTING DIRECT CURRENT FOR SERIES ARC LIGHTING AND ALTERNATING CURRENT FOR INCANDESCENT LIGHTING AND POWER PURPOSES.

The electrical and mechanical equipment of the Boston Electric Light Company's central station, which is located in South Boston, Mass., is probably more complete and modern than that of any of the large electric lighting central stations of the United States; this means, naturally, of the world as well.

Up to last year the Boston Electric Light Company operated no less than four generating stations, each with the usual mixture of power units of various types and sizes, belted to a large number of dynamos representing almost all classes. These have been superseded by one large and elaborate station which occupies the water frontage of a 15-acre tract on the site formerly covered by the historic shipyards of Harrison Loring. It has been designed with reference to the probable future of the city and of the art of electric lighting as well, advantage being taken of the latest methods of electric light distribution and plans made both for such extensions and changes as the future may make necessary.

The building of the station consists of two main bays which are separated by a fire wall. Each is covered with a hollow tiled roof, nearly flat, carried on steel trusses and supported on steel columns which are built in the brick walls. The plan of the building is for the accommodation of six batteries of boilers, two boilers to the battery, on one side and six engine units on the other side of the fire wall. Of the engines four are already in place, as are four of the batteries of boilers. Work has just been begun on the addition of the other two units of each type. The boiler room also contains a gigantic coal pocket having a storage capacity of 6,000 tons of coal. This room is separated from the fire room by a wall which is of temporary character and does not help in supporting the roof, so that in case of necessity it can be removed and another set of boilers put in where the coal pocket now is. The width of the engine room is sufficient to accommodate two rows of generating units if necessary, so that the station may be doubled in capacity in the future if the requirements of the district it serves demand such an increase in capacity.

The building is of plain exterior, and is constructed of red brick resting on a rough stone foundation which is carried down to a solid sub-stratum of compact gravel at a depth of nine feet below the surface. Its general appearance is well shown in one of the illustrations. A brick smoke-stack, 225 feet high and having an octagonal base 22 feet in diameter, rises from the building and forms the most impressive feature of the landscape in that part of Boston. The chimney is 11½ feet in bore throughout. It rests upon a concrete and grillage foundation, 19 feet deep, the grillage consisting of steel I-beams. The upper end of the chimney is covered by a sectional cast-iron cap weighing 14,000 pounds, the joints of this being lapped and leaved.

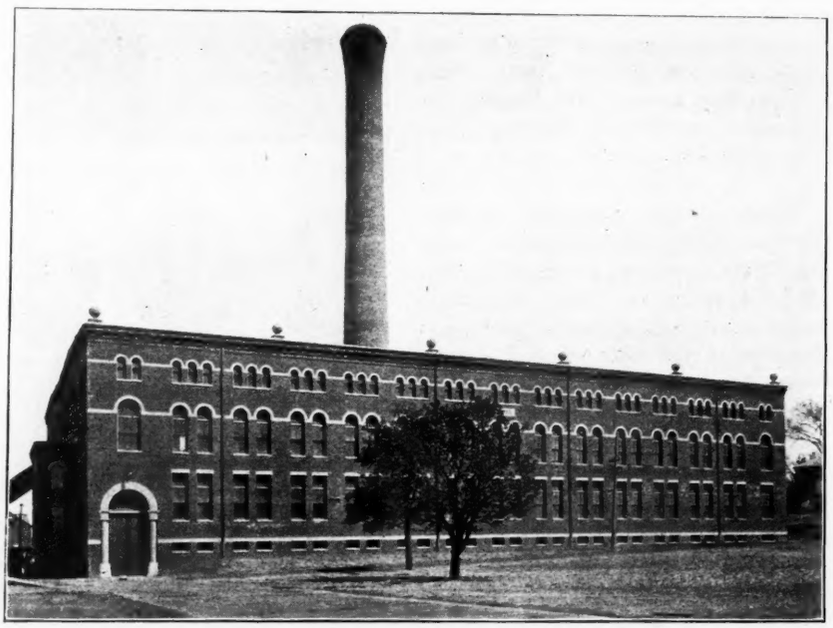


FIG. 1.—EXTERIOR OF BOSTON ELECTRIC LIGHT COMPANY'S NEW STATION.

Use is made of the space between the fire-brick lining and the shell of the chimney as a ventilating flue for the engine room, which is thus kept cool and well ventilated at no extra cost for power or apparatus. The interior of the engine room is lined with white enameled bricks and the ceiling is plastered with white cement. The effect of this, with the numerous windows, is to maintain an admirable illumination in all parts of the great dynamo room. The windows are glazed with flock glass which does not permit the casual observer to look in or direct sunshine to come in, but gives a well-diffused illumination. This room, with its high ceiling and lightness of color, is probably the finest engine and dynamo room in existence.

The station is absolutely fireproof as far as any building may be. The few doors in it are covered with sheet-steel, plated with copper, this being stronger than tin, rendering the wooden doors fireproof. The floor of the engine room is of Terrazzo mosaic. All the interior wiring for the crane, lights, etc., is rubber-covered wire run through hollow tiles situated properly in the walls to form interior conduits, or in fibre tubing in the floor laid directly in the concrete substratum of the floor mosaic. The decoration of the main engine room is exceedingly neat. Thirty-two enclosed arc lamps, hung high on the walls, light the great room, and besides these there are incandescent lamps mounted directly on the engines and on top of the switchboard in addition to pilot lamps on the machines, and abundant lamps in the wheel pits and other dark places. The dynamos are painted a dark maroon color and the whole station, as may easily be judged from the illustrations, is kept in the most admirable condition of neatness. In addition to being a highly efficient station, it is also a very beautiful one. While no direct expenditure has been made for the sake of purely æsthetic effects, no opportunity has been lost to make the station attractive and neat.

Coal comes to the station by boats and barges from Norfolk, West Virginia coal being used. It is received at the end of a pier over 150 feet long, running out into the harbor. Upon this travels a movable crane or tower. This appliance has a boom from which buckets can be let down into the holds of barges or other vessels, bringing up the coal. The boom is provided with several motions so that it

can be handled in close places between the masts of vessels, etc., and adjusted so that the buckets will readily drop down the hatches of the coal buckets. The capacity of the apparatus is 100 buckets per hour. It

FIG. 2.—THE COAL-HANDLING TOWER, BOSTON ELECTRIC LIGHT COMPANY'S STATION.

was built by the King Bridge Company, the remainder of the coal conveying machinery having been constructed by the C. W. Hunt Company. While the tower may be moved, in practice it generally remains near the end of the pier, as shown in the illustration, the boats being moved to bring their hatchways under the bucket.

Along the boom runs a trolley from which is suspended a Rawson tub which is lowered into the vessels and brings up one ton of coal at each trip. The bucket is run back and dumped into a hopper over a sliding grate. This sifts the coal roughly, lumps more than 10 inches in size not being able to pass through its bars. These large lumps are sent to the crusher, from which the coal descends to the filler of the conveyor. Both the tower, which is movable along a wide gauge track on the pier, and the hoisting apparatus are operated by a 500-volt direct-current motor controlled from the tower by the Ward Leonard system, the field rheostat of the generating dynamos in the station being in the line. It requires only two men to handle the tower, which is supplied with current by flexible cables and plugs which may be inserted in receptacles at various places along the pier.

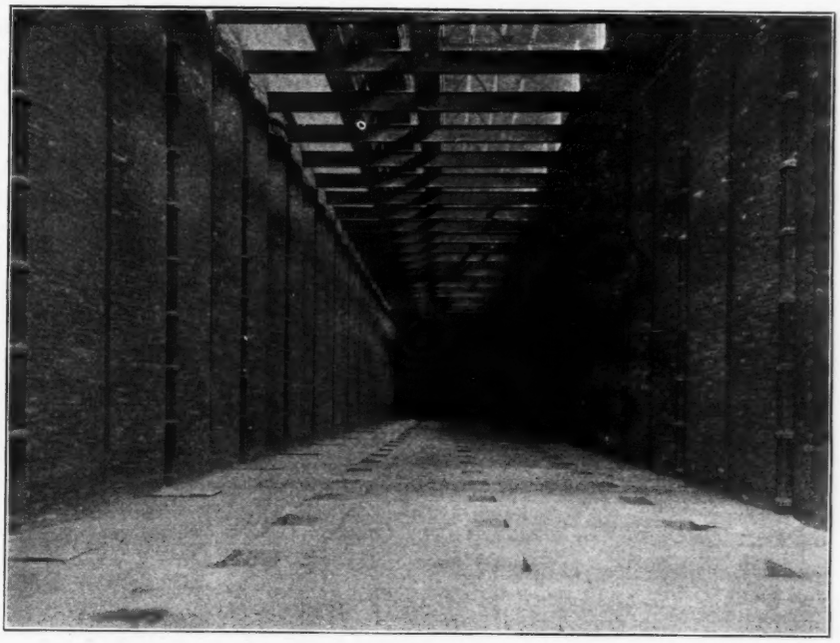


FIG. 3.—THE COAL POCKET, BOSTON ELECTRIC LIGHT COMPANY'S STATION.

The conveyor is very long, having altogether 742 buckets. It is driven by a General Electric Company's 15 horse-power three-phase induction motor. Running along the dock, it ascends on an incline and enters the building above the coal pocket, over the top of which it runs.

The coal pocket is well shown in one of the illustrations. It is 240 feet by 30 in area, and runs the whole length of the

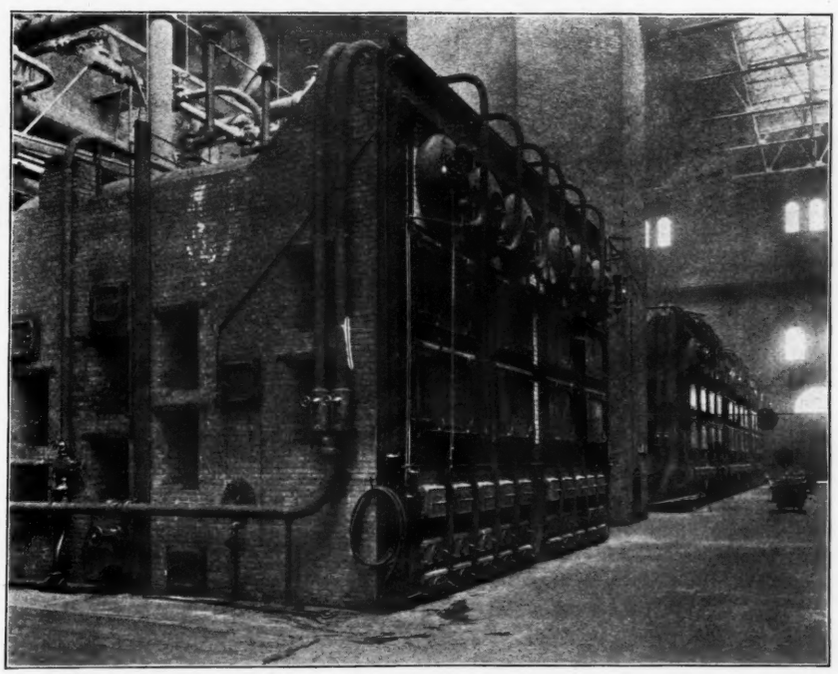


FIG. 4.—THE BOILER ROOM, SHOWING THE BASE OF THE STACK, BOSTON ELECTRIC LIGHT COMPANY'S STATION.

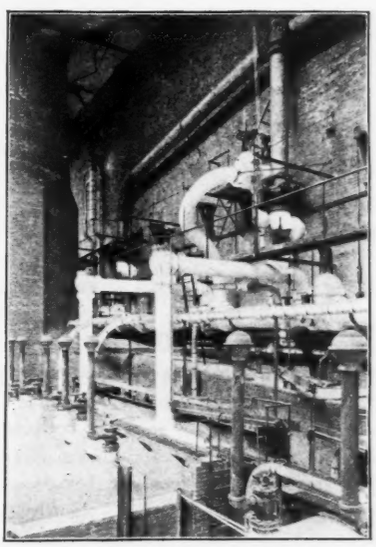


FIG. 5.—PIPING OVER THE BOILERS, BOSTON ELECTRIC LIGHT COMPANY'S STATION.

building. It contains, when full, 6,000 tons of coal. The floor of the pocket is above the level of the boiler room floor so that small cars may be run under it to hoppers and filled to carry the coal to the furnaces. The walls of the pocket consist of brick arches turned with their convex sides inward to resist the thrust of the mass of coal. At every other column of the steel skeleton of the pocket a cast-iron ventilating pipe is arranged so as to withdraw quickly from the coal any gases that may be generated in it. The mass of coal is frequently tested for rising temperature, and when a hot place is found, coal is drawn and used from the chute immediately underneath, which moves all the coal in that locality. Fires in the pocket have been entirely avoided by this simple means.

The eight boilers at present installed are rated at 550 horse-power each, on the "Centennial rating" of 30 pounds of water per horse-power hour. They are of the triple-drum Babcock & Wilcox type, and are grouped in batteries of two, each battery being sufficient to supply one of the main engines, which are rated at 2,350 horse-power each upon a guaranteed consumption of 12½ pounds of water per hour. The boilers are driven at 160 pounds pressure. Hawley down-draught furnaces are used with them and the stoking is by hand. The coal is coked on the grates and the fires are practically smokeless. Back of the boilers is a brick smoke-flue 6 by 10 feet in section, supported on I-beams and lined with fire brick, which leads the combustion gases to the stack. All the upper drums of the boilers are covered with magnesia sectional covering over which is laid a course of bricks and Portland cement. The illustration of the boiler room plainly shows the arrangement of the boilers and the base of the great stack, which stands in the middle of the line of boilers, three batteries to stand, finally, on each side.

The piping arrangements of the station are very elaborate. The main header is on the boiler room side of the division wall and is 20 inches in diameter. It is hung from brackets and has both transverse and longitudinal sliding motions. The steam coming from the boilers passes through 10-inch nozzles and then to Pearson automatic valves which prevent a backward flow or a rush of steam in case of accident to a tube. The steam passes from the header through a bend or loop of copper wire into a Cochrane separator and thence through the wall to the stop-valve on the engine. All of the steam piping, with the exception of these copper bends, is lap-welded steel, with the flanges screwed on. The valves on all the piping are arranged by means of gear wheels to be operated from the floor, but a gallery is also built, running conveniently near the valves, so that they may be worked by hand from it. The main header is provided with two gate-valves close together at its centre and is anchored between them. It also has valves between each battery so that any section can be removed without shutting down more than one boiler in consequence.

Exhaust steam comes from each engine through a 24-inch pipe. These pipes run back to the boiler room and are combined in groups of three to risers for atmospheric exhaust when this is used. The exhausts branch off on the engine room side of the wall, each one going downwardly through a 24-inch gate valve to a jet condenser, first passing through a surface heater of the National Pipe Bending Company's make. The water for condensing is taken from the harbor and comes in through a sluiceway three feet wide and seven feet deep. The condensers discharge into Blake vertical twin air-pumps, controlled by Mason regulators, and these deliver the hot water through a 36-inch main buried in concrete to the harbor again. The boiler feed water is taken from the city mains, the city water being very pure and soft, and admirable for the purpose.

Boiler feeding is accomplished by electrically-driven pumps. Three of the Goulds type triplex pumps are geared to 30 horse-power induction motors, each outfit having a capacity of 200 gallons per minute. These are connected to the city water mains and feed into a six-inch feed main, from which the water passes through the feed water heaters or direct to the boilers as desired. The feed is controlled by hand-operated by-passes, the pumps being kept running at a constant speed. The normal course of the water is through the feed-water heaters described above and then in series through auxiliary heaters, one for each engine, these taking the exhaust of the air-pumps and other steam auxiliary machines. Thence the water goes either to the front or rear of any boiler. Injectors are also installed as a reserve force of feed water supply. The whole feed water system is equipped with drawn brass piping and cast brass fittings.

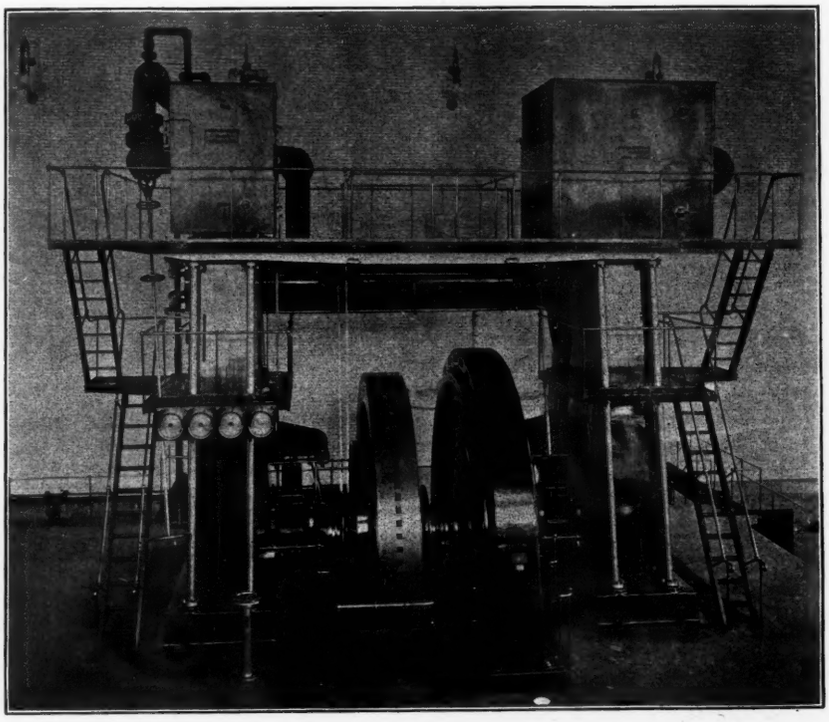


FIG. 6.—ONE OF THE GENERATING UNITS IN THE BOSTON ELECTRIC LIGHT COMPANY'S STATION.

A motor-driven air compressor furnishes the station with a supply of compressed air at a pressure of about 50 pounds per square inch. This is used for blowing dust off the machines and switchboards and also to keep a pressure upon the oil supply, and for operating the pneumatic switches on the generator circuits. The oil is contained in three 400-gallon pressure tanks, situated in the basement below the engine room. Two of the tanks are for engine oil and one for cylinder oil. The oil flows under pressure to small tanks on the cylinder platforms of the engines, whence it is fed to all parts of

the engines in the usual way. The drips are returned to Cross oil filters fitted with steam heating pipes.

The engines are of vertical cross-compound type with a rating of 2,350 horsepower each at economical cut-off. Above this they have a large over-load capacity. They run at 120 revolutions per minute, their piston speed being 960 feet per minute. The engines are of the side-crank type, with the dynamos mounted on the shaft between the frames. The cylinders are 28 by 58 inches in diameter respectively, with 48 inches stroke. All the cranks and connecting rods are housed in with sheet-iron to avoid the throwing of oil. Each engine is provided with a 100-ton, 16-foot flywheel and a shaft governor within its hub, which controls the cut-off valves of both cylinders. The high-pressure cylinders are steam-jacketed, and between the two cylinders of each engine is a receiver containing brass steam coils. The shaft is 26 inches in diameter in the middle, reduced to 21 inches at the bearings, which are each 42 inches long. The crank pins are 10½ by 10½ inches, and the cross head pins 9½ by 10½ inches in size. The piston rods are five and one-half inches in diameter. The valves of the engine are of the grid-iron type, peculiar to the design of engines built by McIntosh, Seymour & Company, of Auburn, N. Y., who built these; they run across the cylinder heads. The engines are guaranteed for a two per cent regulation between no load and full load and are guaranteed to give uniformity of rotation throughout the stroke to within one-tenth of one degree. These engines were described somewhat more fully in the ELECTRICAL REVIEW for April 25, 1900.

An ingenious arrangement for controlling the governors of the engines from the switchboard has been introduced since they were installed in the station. On the hub of the flywheel of each engine a direct-current motor of one-quarter horse-power is securely attached. This motor drives, through a spur-and-worm-gear reduction, a screw which operates on a spring counteracting the centrifugal force of the shaft governor weights. Four collector rings on the main shaft permit current to be sent to the motor, four being used in order to make the machine reversible. The circuit is controlled by a small double-throw switch on the generator panel of the main switchboard. When this is put in one position the motor turns so as to stiffen the spring of the governor and this causes the engine to go faster. Throwing the switch in the other direction causes the engine to run slower. When the switch is open the motor remains stationary and the adjustment of the governor is unchanged. It is, of course, preferable to synchronize by this method rather than by throttling the engines, and the speed of the engine is brought in this ingenious way directly under the control of the switchboard attendant. By means of these motors the load may be shifted from one machine to another at any time or distributed in any proportion among them. It is possible also entirely to throw it off before opening the switch to shut down the machine. By this method a generator can be cut in or out without in any way affecting the others in parallel with it.

FIG. 7.—THE FOUR GENERATING UNITS AND EXCITERS, ARC LIGHTING GROUPS IN FOREGROUND AND GREAT CRANE IN BACKGROUND, BOSTON ELECTRIC LIGHT COMPANY'S STATION.

The four engine units are direct coupled to General Electric three-phase 60-cycle generators, rated at 2,250 kilowatts each at 2,250 volts at 120 revolutions per minute. These machines are of the standard type that has so frequently been described as to render repetition of their description unnecessary. The rotating part carries 60 poles, wound with copper strap, edge on, and insulated with mica. The stationary part is of the usual laminated iron construction, the coils being

arranged overlapping in slots, which are spaced two slots per pole per phase.

At present the station contains three exciters; one of these machines consists of a six-pole, 50-kilowatt, 125-volt dynamo, direct coupled to an Ames high speed engine. The other two units are 75-kilowatt, four-pole machines direct coupled to synchronous motors, the outfits running at 600 revolutions per minute.

Only two varieties of current are supplied directly from the station itself. The high tension three-phase current generated by the large dynamos described above, is fed to one sub-station, situated at Park Square in the city of Boston proper, and also to a network of circuits extending through the business portion of the city. Upon these circuits the current is fed as single-phase, the incandescent lighting of the city being accomplished by this variety of current exclusively.

A very large number of arc lights is also supplied from the station, 2,700 street lights being maintained for the municipality of Boston, and nearly the same number of commercial lights for private consumers. These lights are all of the direct-current enclosed type, and are fed by Brush double-circuit 125-light machines, working at 6.8 amperes, and driven by direct-coupled synchronous motors. Each of the motors is of 150-kilowatt capacity, and is coupled to one machine at each side. On the main floor of the station twenty-eight such sets are installed. They are excellently shown in the interior views of the station. These machines are started in the usual way by compensators and afterwards, when synchronism is established are switched directly upon the main circuit of the three-phase current. In this way the machines are practically electrically coupled to the large generators, and the station is entirely free from belts or other mechanical devices for power transmission of any kind.

An interesting set occupies a position near the middle of the main floor of the engine room. This consists of a 150-kilowatt synchronous motor direct coupled to two machines; one of these is a 500-volt direct-current six-pole generator, and the other is a two-phase dynamo, which is used as a single-phase machine to supply current when needed to circuits that have become grounded.

Spanning the engine room is a traveling crane which runs its full length. The crane has a span of 82 feet, and is capable of lifting 25 tons. It is operated by 500-volt direct-current motors, the current from these coming from the Park Square sub-station. The 500-volt dynamo described above is used only at night when the sub-station shuts down, and to supply current for the coal conveying apparatus when this is in use. The crane was built by the Morgan Engineering Company, of Alliance, Ohio.

FIG. 8.—TYPE OF ENCLOSED ARC LAMP FOR STREET LIGHTING IN BOSTON.

The main switchboard of the station is two stories high, the lower part being given over to panels controlling the motors operating the arc machines, the arc circuits, and local circuits about the station. The board was constructed by the

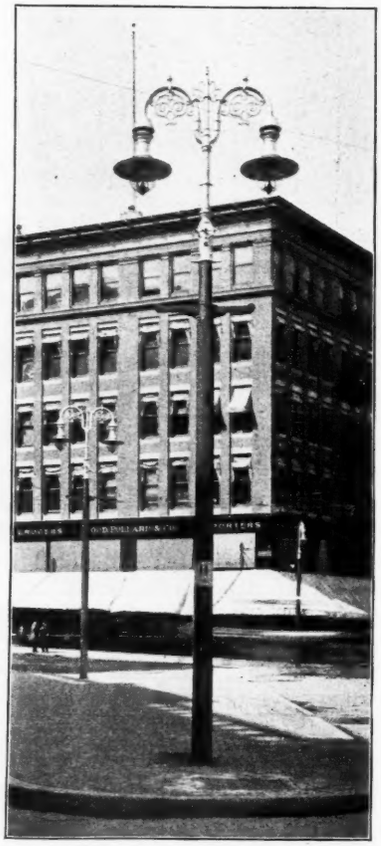


FIG. 9.—ONE OF THE DOUBLE ENCLOSED ARC LAMP FIXTURES IN DEWEY SQUARE, BOSTON.

Boston Electric Light Company itself. For the control of the synchronous motors operating the arc light dynamos, there is installed upon each panel the following apparatus: Two ammeters, of which one is in circuit with the field of the machine, and the other with one phase of its operating current; one wattmeter, and the necessary switches, of the oil-break type.

The arc switchboard is of the usual plug pattern, but is provided with several ingenious and useful accessories. A testing panel near one end of the board contains a high reading voltmeter. Push-buttons near each plug hole on the board, enable connection to be made by means of electromagnetic relays with any circuit that is in operation. A highly ingenious arrangement enables any circuit to be opened and connected through the ammeter; this is accomplished by means of small bus-bars behind the board, which are so arranged that a plug resembling a telephone jack-plug may be inserted in appropriate holes in the front of the board, connecting the various circuits with the ammeter. As there is only one such plug in the stations there is no danger of two circuits being simultaneously plugged on the ammeter and cross connected.

The upper story of the switchboard contains the main machine panels. These are very simple, each being composed of three ammeters, one for each phase; a voltmeter and ampere meter for the field current; an indicating wattmeter and a valve for operating the pneumatic oil-break main switch. Next to these panels in line is a totality panel containing two electrostatic ground detectors; a voltmeter; three ammeters, and three kilowatt meters for registering the total output of the station.

All the exciting current used in the station is fed through a totalizing panel on the switchboard which registers, on two wattmeters, the total of energy used for exciting the main machines and the synchronous motors used in driving the arc lighting apparatus. The somewhat curious refinement is necessary on account of the fact that the contract between the Boston Electric Light Company and the municipality of Boston for street lighting is in a measure contingent upon the total expense of the company in providing electric lights, and that, therefore, it is necessary to know with great exactness the amount of power required and of current dispensed in the maintenance of the city lighting system.

Next this panel are two others containing switches for four 500-volt feeders, which will, in future, be sent out from the station as the stationary motor business in nearby districts increases. Following these are two panels for the three-phase lines to the sub-station at Park Square. The board is completed by seven other panels containing apparatus for the control of 14 single-phase feeders used in the incandescent lighting of the district of Boston served by the company. Oil-break switches operated by hand through long wooden rods, are used in these circuits.

On the back of the main switchboard the bus-bars are composed of pure aluminum suspended in cast-iron hangers from which they are insulated by blocks of gray marble. One and one-half tons of aluminum are used in these bus-bars, and it is considered by the company's engineers

that the use of this metal has resulted in a great saving of weight as well as of cost.

All of the circuits emenating from this station run underground, there being two lines of conduits, each of which contains many ducts. At present one sub-station is operated at Park Square, in Boston proper, where there is a rotary converter supplying current to direct-current motors in its immediate vicinity. The major portion of the station's output, however, is used for electric lighting. Incandescent lamps to the number of about 100,000 are supplied on the various phases of the 60-cycle alternating current from the main generators. There is no intermediate transformation, the 2,250-volt current being sent out at this pressure to the individual transformers on consumers' premises. The arc lighting system of the company, however, is unique, as all of the 5,000 arcs burned from its main station are of the enclosed type. The lamps are of a very simple type, devised by Mr. F. A. Gilbert, the president and general manager of the company, and made in the company's shops. They are mounted in neat goose-neck fixtures for street lighting, these being double at important points. The illustration shows one of these double street fixtures in Dewey Square, just in front of the Southern Terminal Railway station. On the average, these lamps are trimmed once in eight days. Before the installation of the enclosed arcs 52 trimmers were kept busy, but now only seven men to look after the lamps and one boy at the station are required. The ingenious method for banking this work is due to Mr. E. O. Lundin, the manager of the company's repair shops. Each trimmer is provided with a horse and wagon in which is packed a day's supply of inner globes for the arc lamps, each with the lower carbon in place. When the trimmer goes to a lamp he replaces its inner globe with one of these, puts in a new position carbon, and brings the old globe and remnants of carbon back to the station with him. Here the carbon is sorted, that long enough being used again as lower carbons, while the short scraps are returned to the manufacturer. The dirty inner globes are washed by means of an electrically-driven bottle-washing machine of special design, which washes 200 per hour and leaves them *clean*, something the trimmer can not do when the globe is in a lamp on a pole.

The Boston Electric Light Company, under the management of President Fred A. Gilbert, has an enviable record for efficiency of service and progressiveness of management. Its equipment to-day is a model for electric lighting stations elsewhere.

The officers of the company are as follows: F. A. Gilbert, president; E. B. Maltby, vice-president; Samuel S. Sias, treasurer; F. A. Gilbert, general manager; Sidney Hosmer, assistant general manager; J. O. Whitney, chief engineer; Leonard L. Elden, chief electrician; Emil O. Lundin, manager repair shops. The directors are: F. A. Gilbert, E. B. Maltby, E. W. Burdett, William Butterfield, Charles L. Lovering, W. A. Paine, Charles Lowell and Samuel S. Sias.

The following concerns supplied the various features of the equipment as designated:

Coal tower and handling apparatus, King Bridge Company, Cleveland, O. Conveyor, the C. W. Hunt Company, New Brighton, Richmond Borough, New York city. Boilers, the Babcock & Wilcox Company, New York city. Furnaces, the Hawley Down Draft Furnace Company, Chicago, Ill. Steam Separators, the Harrison Safety Steam Boiler Company, Philadelphia, Pa. Heaters, the National Pipe Bending Company, New Haven, Ct. Engines, McIntosh, Seymour & Company, Auburn, N. Y. Air Pumps, the George F. Blake Manufacturing Company, New York city. Feed Water Pumps, the Goulds Manufacturing Company, Seneca Falls, N. Y. Crane, the Morgan Engineering Company, Alliance, Ohio. Electrical apparatus of all kinds, the General Electric Company, Schenectady, N. Y.

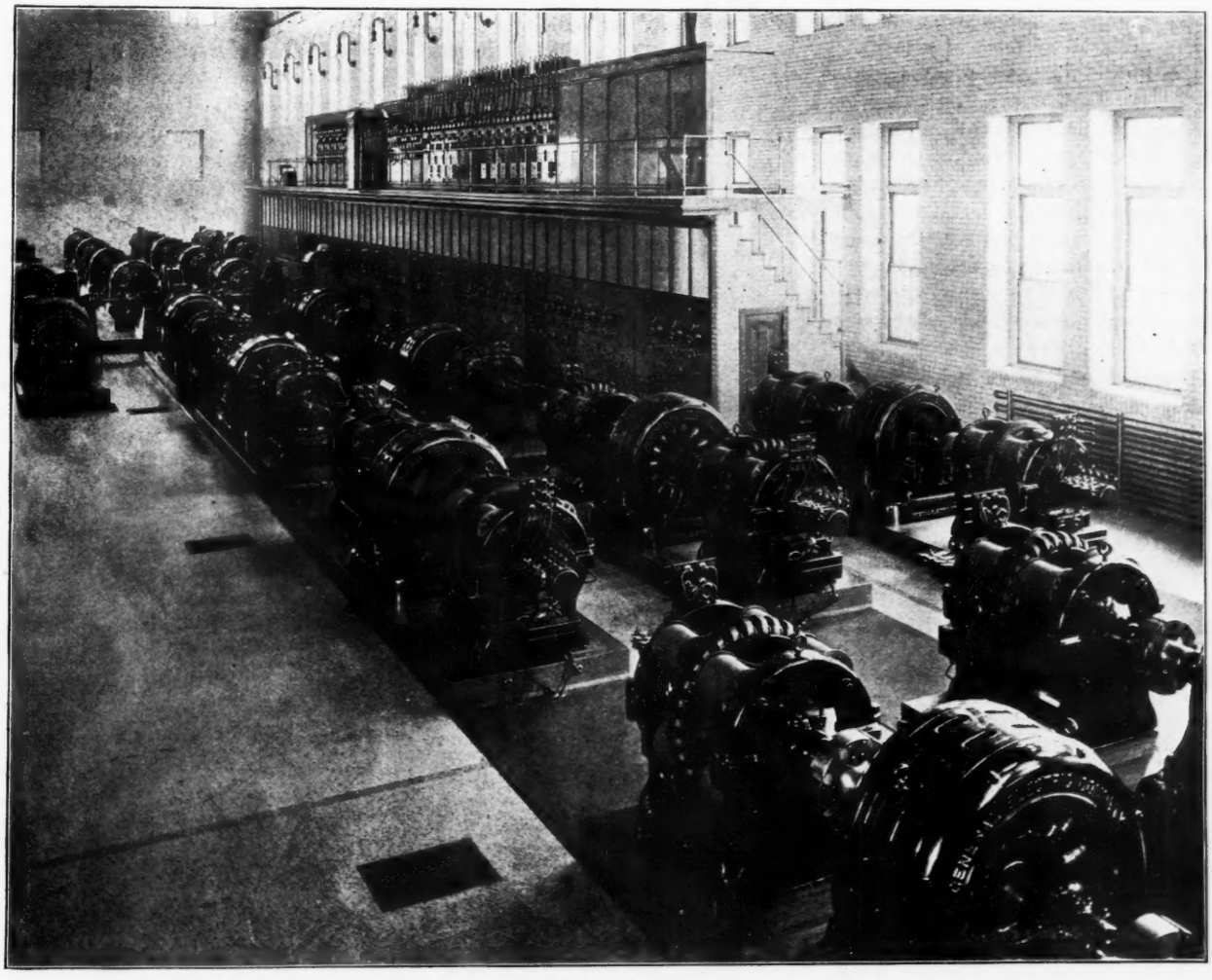


FIG. 10.—ARC GENERATING GROUPS AND MAIN SWITCHBOARD IN THE BOSTON ELECTRIC LIGHT COMPANY'S STATION.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

MR. CARL HERING ELECTED TO THE PRESIDENCY—THE GENERAL MEETING IN PHILADELPHIA.

The seventeenth annual or business meeting of the American Institute of Electrical Engineers was held on the evening of May 15, at 12 West Thirty-first street, New York city. The evening was given over to the reading of one paper, to the counting of the ballots for the election of officers, and the reports of the council, of the secretary and of the treasurer. The reports were all of them of a distinctly satisfactory character, the treasurer's report being particularly gratifying, and showing that the institute is in admirable financial condition. For several years past the council has reported various funds as being deposited with different trust companies. During the past year the council decided to withdraw sufficient funds to purchase $5,000 of Government three per cent bonds, and $2,000 to be placed at interest.

During the year, 45 applications for transfer from associate to full membership have been considered and 26 of the applicants recommended for transfer. The present total membership is 1,273. During the year two members, S. Dana Greene and James Hamblet, and three associate members, William F. Kelly, Charles T. Rittenhouse and Alexander Stratton, died.

After the presentation of the reports, Mr. J. Hindon Hyde, a member of the New York bar, read a paper entitled "Experts and Expert Evidence." This paper, which was of considerable length, dealt with the interesting question of the position of experts in patent cases and other cases where technical knowledge is involved, and with the qualifications which should be possessed by an engineer desiring to serve professionally as an expert. The paper was a synopsis of the duties and proper qualifications of such experts from a lawyer's point of view and ended with the suggestion that it would, perhaps, be better for courts considering such matters to have a regular expert in their employ who would not take sides with either of the parties in litigation, but should advise the court in regard to technical matters.

The discussion following Mr. Hyde's paper was long, and showed that there were as many diverse opinions on the subject of the paper as there were members present. The discussion was opened by Mr. E. P. Thompson, who spoke of the tricks of the trade which it was necessary for the discerning expert to know in order that he might circumvent the crafty lawyer on the other side. He told a story concerning the value or rather the lack of value of photographs as evidence.

Mr. Thompson was followed by Mr. Jesse M. Smith, who spoke at some length on the actual and legitimate differences of opinion that might exist between men equally honest and equally expert on opposite sides of a case. He contended that an expert should prepare himself carefully and that he should earn his fee by a diligent study of the case before he goes on the witness stand. He gave several varieties of hypothetical questions that had been asked showing that it was often necessary to take several days' time to answer a question, and in illustration of the difference of opinion that might exist about simple things, cited a case of a rheostat and an electric heater. Both these instruments are resistances, but it is hard to say whether a given structure is a heater or a rheostat when evidently it may be used for either one.

Mr. C. L. Clark spoke at length and very well in support of the positions taken by Mr. Hyde, and finished by introducing Mr. Edward S. Renwick, the Nestor of the profession. Mr. Renwick stated that in his experience as an expert witness, which had now extended over more than 50 years, he had found out that the one absolutely necessary qualification beyond knowledge of the subject which an expert must possess in order to succeed is honesty. The expert should know his case but he should not forget that no amount of expert testimony makes a case; it simply stirs it up and ventilates it and gives both sides of the question and then the judicial function is necessary for its settlement and decision. Mr. Renwick said that he had advocated for many years an appellant patent court to sit at Washington and to have lay members of the expert class so that some of the long and expensive patent litigations might be facilitated. Messrs. C. E. Dunn and Elias E. Ries also took part in the discussion.

At this point Dr. Samuel Sheldon, who occupied the chair during the absence of President Kennelly, declared a recess of half an hour to enable the tellers to count the ballots for the election of officers. Upon the resumption of the sitting the committee on proxies reported briefly and an amendment to the constitution was offered by Mr. R. L. Bannock concerning Article VIII.

The announcement was then made that the official count for president stood: Carl Hering, 381; M. I. Pupin, 179, and several scattering votes. It was stated by the tellers that the official count for managers of the council could not be completed for several hours and as it was already nearly midnight the meeting adjourned.

THE PHILADELPHIA MEETING—FIRST DAY.

The meeting was called to order by the president, Dr. A. E. Kennelly, promptly at two o'clock in the afternoon of May 16, in the great meeting hall of the Drexel Institute. This hall seats 1,500 persons, and as only 36 members and visitors were present at the opening session it looked somewhat empty. The weather was extremely hot, and this fact made the large vacant spaces of the hall most agreeable.

Secretary Page announced the returns of the election, counted the evening before, and Dr. Kennelly made a felicitous little speech in welcoming the new president, Mr. Carl Hering to the office. He appointed Mr. W. J. Hammer and Dr. E. J. Houston a committee to escort President Hering to the chair. Mr. Hering said, on taking his seat:

"I am grateful for the honor the Institute has done me. I will try, with the other officers, to keep the Institute out of mischief for the next year."

Dr. MacAllister, president of the Drexel Institute, then addressed the meeting. He said, after some sentences of welcome, that in his early years there had been only three professions—clerical, legal and medical, but that in his lifetime two new ones had grown to great proportions, these being engineering and architecture. Of all the kinds of engineering, the electrical is the most interesting because it commands so large and swiftly growing a place in every-day life. Dr. MacAllister then described the Drexel Institute, in whose beautiful building the Institute was so hospitably housed. It is intended to teach artistic, scientific and technical subjects, the work being mostly on laboratory methods. With a brief reference to the traditional hospitality of Philadelphia the graceful address was closed.

In the absence of the Mayor of Philadelphia, who neither came nor sent his apologies, the meeting proceeded to the regular order of business, the first being the reading, by Professor W. E. Goldsborough, of his paper entitled "A New Transmission Dynamometer." The machine described was a dynamometer of the spring type, the angular displacement of the two parts connected by the spring being found at any instant by a simple electrical method involving the use of two contacts and two brushes, with a telephone in circuit. An interesting discussion followed.

Mr. C. O. Mailloux said that he considered this dynamometer the best for practical work that he had seen. He described the Emerson and Van Winkel types, but in these, centrifugal action on the springs introduces considerable and varying errors. He thought the dynamometer described should have some arrangement for visual indication, and inquired if any hysteretic phenomena had been noticed in the springs employed.

Replying, Professor Goldsborough said that this action had not been noticed. He described the ingenious Flather liquid pressure dynamometer, and an arrangement for measuring displacement by means of a resistance wire which had suggested itself to him.

Professor A. J. Rowland said that he particularly liked the telephonic detector employed, because its indications depended upon hearing a sound, not upon noting a silence, which is difficult to do accurately in a place where machinery is running. Mr. Mailloux said that the apparatus could be put to many practical uses, and to many that were not, perhaps, at present apparent.

Mr. Herschel C. Parker then read his paper entitled "A Percentage Bridge." This described a method for the comparison of small differences of resistance, especially applicable in the construction and calibration of resistance coils. It depends on the "substitution in the bridge" method. This is a zero method in which a standard ohm, for example, is balanced in a Wheatstone's bridge, then removed and replaced with the newly constructed coil or coil which is to be standardized. This coil is then adjusted until the bridge is again in balance, when it is, of course, a perfect copy of the standard.

In the new apparatus "percentage coils" are joined to the ends of the bridge wire. These coils can be so adjusted that a single division of the bridge wire may be made of very small value, corresponding to great accuracy in the reading.

Professor Goldsborough said that any labor-saving device in such work as calibration was most welcome, and that a zero method is especially desirable.

Secretary Pope then read invitations from the Cramp's Ship Yards and the Baldwin Locomotive Works giving members the privilege of visiting these establishments, and a formal communication from the Franklin Institute extending the courtesies of that body to the American Institute of Electrical Engineers.

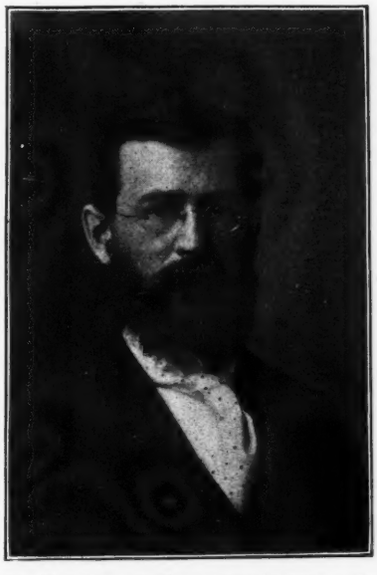
Adjournment was then taken until the next morning.

Carl Hering.

Mr. Carl Hering, who has just been elected to the presidency of the American Institute of Electrical Engineers, was born at Philadelphia, Pa., in 1860, and was graduated from the University of Pennsylvania in 1880, with the degree of Bachelor of Sciences, and later that of Mechanical Engineer. In 1881 he was appointed instructor in mathematics and assistant in mechanical engineering in the University of Pennsylvania. Later he became assistant in physics to Professor Barker, of the University.

In 1883, Mr. Hering was elected commissioner of the Franklin Institute of Pennsylvania to the International Electrical Exhibition at Vienna, and became a member of the international jury which conducted the tests of the exhibits. At the close of the exhibition, Mr. Hering went to Darmstadt, Germany, and continued his studies in electrical engineering under Professor Kittler, at the Polytechnikum. At that time this was one of the few institutions where electrical engineering was taught as a special course. After serving for a short time as Professor Kittler's assistant, he returned to the United States in 1884, and was the acting electrician for the International Electrical Exhibition at Philadelphia, held under the auspices of the Franklin Institute. He was also a member of the commission which made the tests and reports on exhibits. Later in 1884, he returned to Germany and served as electrical engineer for a large manufacturing firm. On returning to Philadelphia, he became consulting engineer for a company there, after which he inaugurated a private practice as consulting electrical engineer, which he has continued up to the present time.

In 1889 Mr. Hering was sent to Paris for the United States Government to report on the electrical exhibits at the Paris



MR. CARL HERING, PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Exposition. He was made a member of the jury representing the United States. For his services he received from the French Government the decoration known as the "Gold Palms." In 1891 he was chairman of a delegation from the American Institute of Electrical Engineers to the International Electrical Congress at the Frankfort Electrical Exhibition, and here also he was made a member of the jury. Mr. Hering did considerable preparatory work in connection with the electrical congress at the World's Columbian Exposition at Chicago, in 1893. He is the author of several publications on electricals subjects, has prepared several papers for prominent engineering societies and has held office in the council and as a manager of the American Institute of Electrical Engineers. For the past few years Mr. Hering has done considerable work in electrical journalism. His latest appointments are as a member of the jury of awards at the present Paris Exposition, and he is an official delegate to the electrical conference to be held at the Exposition in August. He will also represent the Engineers' Club of Philadelphia and the Franklin Institute.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

COMPLETE DAILY PROGRAMME FOR THE TWENTY-THIRD CONVENTION.

The twenty-third convention of the National Electric Light Association, will be called to order by President S. T. Carnes, on Tuesday, May 22, at ten o'clock A. M., in the convention hall of the Auditorium Hotel, at Chicago. The morning session will be preceded by a meeting of the executive committee, which will be held in the secretary's office, at nine o'clock A. M., May 22.

Following President Carnes's address, the Committee on the Photometric Value of Arc Lamps, will render a report through its chairman, Mr. Henry L. Doherty. Captain William Brophy, chairman of the Committee on Grounded Circuits, will follow with his report. The remainder of the programme follows:

AFTERNOON SESSION, 2 O'CLOCK.

Paper, "Exhaust Steam Heating," Harry J. Frith, Watseka, Ill; F. A. Copeland, La Crosse, Wis.

Paper, "Central Station Economies," W. L. Abbott, Chicago, Ill.

Report, Committee on Standardization of Electrical Apparatus, Prof. Francis B. Crocker, chairman.

WEDNESDAY, MAY 23, 1900.

MORNING SESSION, 10 O'CLOCK.

Paper, "Uniform Accounting," Lieutenant James Blake Cahoon, Syracuse, N. Y.

Paper, "Equitable, Uniform and Competitive Rates," Henry L. Doherty, St. Paul, Minn.

AFTERNOON SESSION, 2.30 O'CLOCK.

Paper, "Series Enclosed Alternating Arc Lamps." Prof. William Lispenard Robb, Hartford, Ct.

Report, Committee on Standard Candle-Power of Incandescent Lamps, Dr. Louis Bell, chairman.

Paper, "Combination Electric Lighting, Power and Railway Work," R. S. Feicht, Pittsburgh, Pa.

EXECUTIVE SESSION.

EVENING SESSION, 8 O'CLOCK.

Auditorium Hall.

Paper, "Alternating-Current Generators" (illustrated with stereopticon), H. G. Reist, Schenectady, N. Y.

THURSDAY, MAY 24, 1900.

MORNING SESSION, 10 O'CLOCK.

Paper, "Automobiles as a Source of Revenue to Central Stations," Elmer A. Sperry, Cleveland, Ohio.

Report, Committee on Amendments to Freight Classification, James I. Ayer, chairman.

Topic, "Free Wiring," discussion by Mr. Chas. R. Huntley, of Buffalo, N. Y.; Mr. E. L. Bemiss, of New Orleans, La., and Mr. Dudley Farrand, of Newark, N. J.

AFTERNOON SESSION, 2.30 O'CLOCK.

Report, Committee on Legislative Policy, Samuel Insull, chairman.

Report, Committee on Theft of Current, James I. Ayer, chairman.

EXECUTIVE SESSION.

Reports, Secretary and Treasurer, Executive Committee, Election of Officers.

It is announced that all the machinery in the American section of the Paris Exposition has been purchased by French buyers.

HOT-WATER HEATING FROM A CENTRAL STATION.*

BY H. T. YARYAN.

It does not require the eye of a prophet to foresee the future means of heating and lighting our cities. If heat, using water as a vehicle, can be distributed from a central station covering a territory measured by a radius of one and a half miles from the station, and do it with profit to the investors and entire satisfaction to the consumers, the problem would seem to have been solved. This has been done by the Toledo Heating and Lighting Company for the past five years, a period sufficiently long to place the enterprise beyond the experimental stage, and entitles it to be classed as a successful business venture. It is because I believe the members of this society will in the future be called upon to exercise their skill and knowledge in refining and perfecting the system that I lay the facts and "state of the art" before you, giving freely results of my own experience, in the hope that it will be of assistance when you are called upon for advice.

I think that it will be found that when the new system is generally introduced, in connection with the production of electricity, you will be forced to modify your views on high-pressure steam and the compounding of engines. Where steam economies are of little avail seven months out of the twelve, and where seven months cover four-fifths of the electrical output for the year, there would seem to be little encouragement for heavy outlay in that direction. Fortunately for the system, the demands for heat and electricity run almost on parallel lines a large portion of the year. Under the new system, electricity becomes a by-product, the only cost of fuel being the condensation of engines, which will average probably 20 per cent. Experience has shown that for every dwelling house heated, it requires the exhaust from engines necessary to light four. It therefore follows that the lighting district must be extended beyond the heating, or some other use be found for the output, such as street railroads, if the entire city is to be heated. If some great genius, like an Edison or a Tesla, were to announce to this society that electricity could be produced without cost, I imagine there would be a sensation; and yet the Toledo Heating and Lighting Company is doing this very thing, as the six months' business ending January 1, last, shows, the load being 199 houses heated and 450 lighted.

Receipts from heating	$9,900 88
Receipts from lighting	9,064 78
Fuel	$5,040 63
Wages and salary	2,827 14
Expense (taxes, repairs, oil, waste, etc)	1,896 77
	$9,764 54

I presume the question will be asked why electricity should be treated as a by-product instead of the heat. My answer is that charges for heat can be fixed and maintained, the consumption of coal increasing proportionately with the number of consumers, while the opposite is true of electricity, and a flexible scale of charges is necessary if the large excess of output is to be disposed of.

Most of you will recollect the disastrous

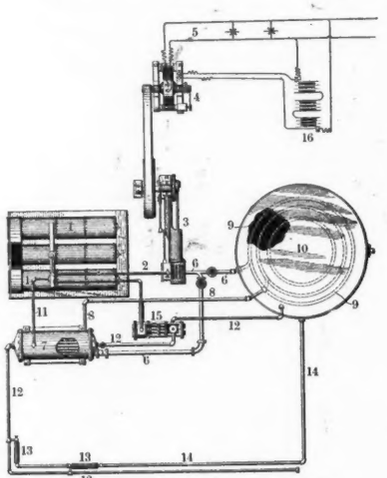


FIG. 1.—HOT-WATER HEATING FROM A CENTRAL STATION—PLAN OF SYSTEM.

failure, in Boston, about 12 years ago, in an attempt to distribute hot water from a central station. A large sum was invested, and the work of installation was of the highest order. I have no direct information as to the causes of this failure, but it is not hard to figure out if one reads the paper of Chief Engineer Abbot before the Boston Society of Civil Engineers. The two mains laid were four inches for outflow of hot water, and six inches for return. The proposition was to heat water to a temperature of 400 degrees Fahrenheit, and to circulate, necessarily, under a pressure of 250 pounds. He says, in his paper, that the maximum rate of circulation would be from 10 to 15 feet per second. If I can figure friction, and making a liberal allowance for the less viscosity of hot water, there would be lost in pressure from three and one-half to eight pounds per 100 feet, or, at the end of a pipe 3,000 feet from station, from 100 to 240 pounds. The effect of this on super-heated water would be to convert a large portion of it into steam, and the small service pipes, of one-quarter to three-eighths inch, to the various houses would not deliver a sufficiency of the mixed steam and water to heat the buildings. Other troubles would follow in the return pipe. The theory was, that when the pressure was reduced inside the buildings, the super-heated water would give up a large per cent of steam, and this was to be used for heating; the water returning to the station by gravity, in a closed circuit, to be again super-heated. Unfortunately, super-heated water will give up its steam inversely as the pressure, and as the pressure must be greater at the extreme end of the line than at the station, it follows that, as the return flow reaches points of lower pressure, steam will again be formed until the pumps reach their capacity for handling the mixed volume of steam and water, when circulation would slow down and practically cease. There are many other troubles which they must have encountered that I could mention, but the one given is sufficient, as it was inherent and fatal to the working of such a system. The surprise is, not that the experiment was a failure, but that intelligent engineers should have given their sanction to such an undertaking.

The system I am about to describe and show in plan (Fig. 1) is so simple that but few words are necessary to make it intelligible. The steam boilers, engines and dynamos are such as may be used in the ordinary electric light station. Heaters of the tubular type, through which the water passes from the pumps to the mains, receive the exhaust steam from the engines, heating the water to any desired temperature. When more exhaust is being produced than is required to heat the water, the excess is delivered to a water storage tank to be used later when the output of electricity is small. The circulating system consists of two wrought iron pipes, laid side by side in the ground, carefully protected by insulation, one pipe for the outflow of hot water impelled by the pumps, the other for the return water from the coils in the various houses heated, going back to the suction end of the pumps, to be forced again through the heaters, where the loss in temperature is restored.

The Toledo Heating and Lighting Company has two stations, known as the Floyd street and the Twenty-second street stations, and although the heating mains of the two stations are separate and distinct, the dynamos of the two stations feed into a common system of electric mains. The

*Read before the American Society of Mechanical Engineers, Cincinnati, May, 1900.

length of the double water mains, that is, ditch, connected to the Floyd street station is 8,550 feet, and the number of houses heated is 101. The length of mains from Twenty-second street station is 8,260 feet, and the number of houses heated is 98. The amount of radiating surface connected with the Floyd street station is about 90,000 square feet, and with the Twenty-second street station about 85,000 square feet. The amount of coal consumed at both stations during the heating season, from October 1 to May 1, averages 5,000 short tons of coarse slack, or about 25 tons to the residence. These same buildings, if heated by their own furnaces would average not more than 18 tons of hard coal each. The difference may be accounted for by the loss of heat in ground radiation, and largely by the fact that we heat the buildings more thoroughly and for a greater number of hours than they could or would do by private furnaces. The loss of heat through radiation in our mains is an important one, and I am sorry not to be able to give positive data, and it is impossible to more than approximate the loss. From careful observation, I estimate the loss to be between 15 and 20 per cent. The water reaches the extreme end of our lines, three-quarters of a mile from the station, in the coldest weather, with a loss of 12 degrees Fahrenheit, which would be an average of six degrees to all of the houses. As the water returns to the station with a drop of 35 degrees, this would indicate about 17 per cent loss in the ground, which I believe to be nearly correct. A pressure of 60 pounds is maintained on the feed line during cold weather and 40 pounds during moderate weather. The service pipes to the various houses are one-inch pipe, and the return line throttled with a disk inside the building, the size of opening depending upon the quantity of radiation, but average five-eighths of an inch. The houses are equipped with radiation sufficient to heat them to a temperature of 70 degrees Fahrenheit, with water entering the house at 160 degrees Fahrenheit, when the outside temperature is freezing. By raising or lowering the temperature of water one degree for each degree of variation in the outside temperature, we are able to maintain a constant temperature in the houses during all kinds of weather. There is no occasion for the consumer to regulate the flow of water during the entire Winter, and, with few exceptions, our consumers open the supply valves in the Fall and only close them in the Spring. The extreme limits of temperature of the water is from 130 degrees in moderate weather to 212 degrees in the coldest.

The insulation used is shown in section, Fig. 2, and is both effective and inexpensive. The top, bottom and sides are made

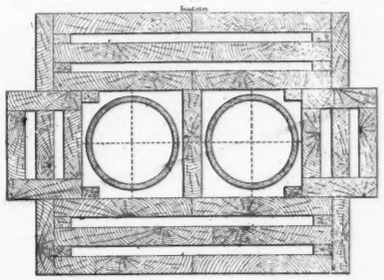


FIG. 2.—HOT-WATER HEATING FROM A CENTRAL STATION—SECTION OF PIPE INSULATION.

in separate sections by using for top and bottom three one-inch boards, separated with one-half-inch strips to form air spaces, with one-inch by four-inch boards on the sides to prevent the entrance of earth. This manner of insulation is as near perfect as can be hoped for, and the only improvement which might be suggested is to creosote the outside boards. After four years of use, the only sign of rotting is in the outside boards which

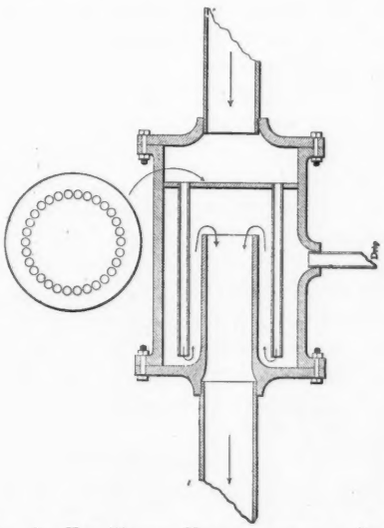


FIG. 3.—HOT-WATER HEATING FROM A CENTRAL STATION—SECTIONAL VIEW OF HEATER.

come in contact with the earth. The heat in the mains keep all other boards perfectly dry, and it would seem that their life was indefinite. The mains are laid in a ditch only 30 inches deep, as we have found by experience that the nearer they are to the surface of ground the less loss by radiation. The reason for this is simple enough, as wet ground is a better conductor of heat than dry, and the deeper you go the longer the ground remains wet.

The heaters are really surface condensers, and I have some hundreds in use for this purpose, the only novelty about them being the manner of providing for the difference in expansion of copper tubes and iron shell. No thimbles or other devices are used to permit a slip through flue sheets, but each tube is rigidly expanded in the top and bottom flue sheet. They are seven feet long, 24 inches in diameter, and contain 500 five-eighth-inch copper tubes. The tube, before entering, is bent so as to make a permanent sag of five-eighth inch, which is intensified to about three-quarter inch in expanding, by the use of a drift.

As all the water of condensation is sent back to the boilers, a thorough separation of oil is necessary. I have found most of the so-called traps a delusion, as they depend upon slowing down the steam current to permit the particles of oil to be dropped. The finer particles, however, are so thoroughly entrained that they are carried to the condensers and thence to the boilers. The trap was really constructed to separate entrained salt water, in distillers on ship boilers under a vacuum, where the speed of vapor is high. The principle involved in separating the volume of vapor into jets by passing through one-inch tubes equal in area to the exhaust pipe, so that only a narrow space intervenes between the end of tube and impinging surface. The smallest particle of entrained substance is carried over this space, by its own momentum, and is held by the impinging surface, where it runs off through the drain pipe. Incidentally, I may state that fully one-half of the oil used on engines and pumps is recovered and used over again.

The provision for expansion on underground mains is of vital importance. After trying all manner of devices, the ordinary U, where the run is straight, and 90 degree bends at corners, answer the purpose admirably and give no trouble whatever. The U's are placed about 600 feet apart, and as the extreme expansion is about three-quarters of an inch to 100 feet, only four and one-half inches are necessary to be taken care of by each U. As the mains are laid cold, we put an extra strain, when laying, on the U's in an opposite direction to that in which they work when allowing for expansion.

Almost the first question asked by a practical engineer is, How about the corrosion of your pipes? I am happy to say that I can answer this question in a satis-

factory manner, as over 10,000 feet of pipe were relaid last summer, after being in use five years. The wrought-iron pipe showed no signs whatever of corrosion, but steel pipe was perceptibly affected. There was a great difference in different lengths of steel pipe, but all were affected more or less. The appearance of the pipe showed the forms of nodules on the inside, varying in number from one dozen to 100 in a length of pipe, and in size from a grain of corn to a hazel nut. When the nodules were removed, a soft under layer of carbon remained, and with the fingernail this could be removed, developing a perfectly round pit from one-eighth to three-sixteenths of an inch deep, but in no instance had the pit perforated the pipe. As a matter of curiosity, some steel pipe which had been in use two years was examined, and found to be in exactly the same condition as that of five-years' use. The action seems to be electrolytic, some particle of impurity forming the nucleus for decomposition of the steel. If any inference can be drawn from the facts stated, it is that the impurity has lost its power to cause electrolysis after being surrounded by a sufficient amount of graphite. The most important lesson taught however, is that only wrought-iron pipes should be used for water circulation.

A test with pressure gauge on the outflow pipe at the extreme end of our lines shows 39 pounds with 60 pounds at the station, or a loss of 21 pounds due to friction. At the same time the pressure on the return line was 28 pounds, and as the friction should be the same on both lines, the difference may be accounted for by the fact that the return line discharges into a tank 15 feet high at the station.

In calculating the size of mains for a given number of houses, it became necessary to know the relative friction of hot water as compared with cold. To my surprise, I was unable to find any data that were of value, and to settle the question I made some tests which may be useful in future work. A run of 450 feet of one-inch wrought iron pipe with numerous bends was connected to a heater, and the water passed through a meter. With a constant pressure of 10 pounds the following cubic feet of water were delivered at the open end of the line in five minutes:

At 34 degrees Fahr...	6.2	At 150 degrees Fahr...	6.6
" 60 " "	6.3	" 185 " " ...	6.75
" 90 " "	6.4	" 212 " " ...	7.9
" 120 " "	6.5		

As it requires an average of 15 gallons per minute to be delivered at each house, and knowing the friction of cold water, the data thus obtained enabled me to calculate the size of mains necessary to give good service to each house, and to always maintain a sufficient difference in pressure between feed and return mains to insure rapid circulation.

As exhaust steam heating from central stations has been introduced to a limited extent, it may not be out of place to call attention to the objections to steam, which do not apply to hot water.

1. The exhaust not being uniform in power plants throughout the entire period of 24 hours, either live steam must be used during the minimum load or exhaust must be lost during the maximum load.

2. The excessive cost of laying steam mains, which must be large and thoroughly protected from infiltration of water. The temperature of pipes being above the boiling point of water, any infiltration is converted into steam, and thus a vast amount of heat is dissipated.

3. It is absolutely necessary that from five to 15 pounds back pressure shall be carried on the engine, which is exceedingly wasteful.

4. The condensation of steam is wasted, and with it a large percentage of heat.

5. The piping of houses is expensive on account of the large size required to convey steam with one or two pounds back pressure.

6. The service is not satisfactory on account of difficulty in regulation, especially in mild weather.

7. The offensive smell, due to vents and leaky stuffing boxes.

8. Water hammer, due to condensation in house pipes.

9. The quality of heat, especially where direct radiation is used.

10. Danger from fire, which has been abundantly demonstrated, can arise from long continued contact of steam pipes with wood, in an enclosed place.

11. Greater loss by radiation in ground, due to an average higher temperature of mains.

12. The necessity for sewer connections to remove condensation in mains where traps may form.

13. The rapid destruction of all iron drips, due to the solvent action of distilled water.

14. The filling of the entire system with air when a shut down occurs for any length of time.

The only counter charge I have ever heard made was that it required live steam to run the pumps. But this is largely offset by the back pressure on engines in the steam system, and can be made a large source of profit by selling the heat, as none is wasted.

During the past two years the system I have described has been installed and is now in successful operation in the following cities and towns: La Porte, Ind.; Mattoon, Ill.; La Crosse, Wis.; Kenosha, Wis.; Alton, Ill.; Portage, Wis.; Boone, Perry, Ida Grove, Iowa Falls and Mason City, Iowa.

During the present summer the company which I represent will install a refrigerating plant for domestic use, distributing cold brine in exactly the same manner that we do hot water, but using a separate set of mains. We shall use an ammonia absorption machine, operated with exhaust steam, so that as the demand for heat ceases that for cooling purposes begins, thus utilizing the exhaust steam from our engines during the summer months, which now goes to waste.

An Independent Telephone Meeting.

The Ohio managers of independent telephone companies held a meeting in the Electric Building, at Cleveland, Ohio, on May 9 and 10. This meeting was called for consultation between the officers of the United States Telephone Company, which owns the long-distance independent system in Ohio, and the local managers of the various exchanges. The register showed an attendance of 83 managers, which, together with the local people, made about 100 present at the different sessions of the meeting.

The visitors were entertained by the United States Telephone Company at luncheon and dinner, and at the Empire Theatre in the evening. H. D. Critchfield, general counsel of the United States Telephone Company, was made chairman of the meeting, and the best means of operating long-distance toll lines in conjunction with the local exchanges occupied the greater part of the discussion, but other subjects were considered and a policy agreed upon.

Two committees were appointed; one a committee on specifications, composed of: Maxime Reber, of Cleveland; S. M. Strong, Ashtabula; A. H. Reutinger, Chillicothe; M. M. Herron, Millersburg, and George Metheany, of Lima. This committee is to adopt specifications for the construction of lines which will be followed by all the companies. Another committee on farmers' lines was appointed, composed of: Frank L. Beam, Columbus; E. U. Hide, Orangeville, and W. S. Wagner, Tiffin.

The directors of the New England Telephone and Telegraph Company have been authorized to increase the capital stock of the company from $15,000,000 to $20,000,000.

THE ELECTRICAL COLLECTIONS IN THE NATIONAL MUSEUM—III.

BY GEO. C. MAYNARD.

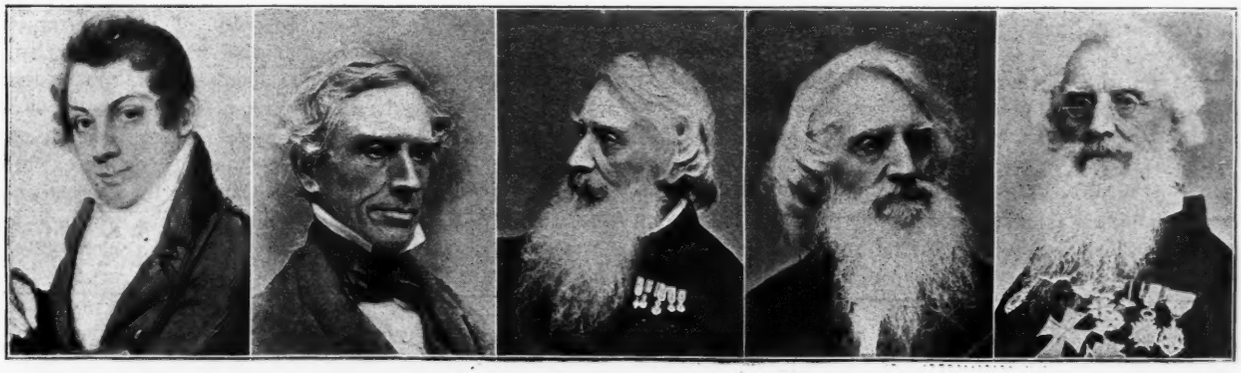
One of the most prominent departments in the National Museum is called the Hall of American History. The purpose of the exhibits arranged in it is to illustrate the great events in the history of the country and record the deeds of the men whose successful labors in the establishment and development of the nation have been epoch-making. These begin with a statue of Leif Ericsson and end with a wagon-load of loving cups, jeweled swords and other rich mementoes of the exploits of Admiral Dewey. Among a large number of cases containing relics of the most distinguished American statesmen, soldiers and scientists, electricity is represented by three cases devoted to Henry, Morse and Field.

FIG. 1.—THE MORSE CASE IN THE NATIONAL MUSEUM, SHOWING THE FIRST RECEIVING TELEGRAPH INSTRUMENT.

The most important object in the Morse telegraph collection, and one of the most valuable historical relics in the Museum, is the first receiving telegraph instrument made by Morse, the real value of which has never been appreciated. Its preservation is a piece of great good fortune. It was carefully kept by Morse himself, until shorly before his death, in 1872, when he gave it to the Western Union Telegraph Company. For some years it was on exhibition in the receiving room in the basement of the company's building, on Broadway, New York, where it was examined by thousands of visitors, including many telegraph operators, but few of them comprehended the fact that the crude, clumsy machine might have been carried to the operating room, placed in the circuit of any line radiating from that centre and used in the regular course of business to receive messages by sound. Under the most careful and stringent precautions to ensure its safety and prompt return, the company allowed the instrument to be exhibited at the World's Fair, in Chicago, and in September, 1895, President Thomas T. Eckert, with the approval of the company's board of directors, deposited it in the National Museum, where it is installed in a special case devoted to the exhibition of a collection of objects illustrating the beginning and development of the electromagnetic telegraph.

Professor Morse conceived the plan of his system of telegraph and drew sketches of the apparatus for transmitting messages by means of the electric current, in 1832, constructed this machine in the Fall of 1835, and gave a public exhibition of it, in operation, September 2, 1837. His own description of it is as follows:

"This first instrument was made up of an old picture, or canvas frame, fastened to a table; the wheels of an old wooden weight to carry the paper forward; three wooden drums, upon one of which the paper was wound and passed thence over the other two; a wooden pendulum, suspended to the centre of the top piece of the picture or sketching frame, and vibrating across the paper as it passed over the centre wooden drum; a pencil at the lower end of the pendulum, in contact with the paper; an electromagnet fastened to a shelf across the picture or sketching frame, opposite to an armature made fast to the pendulum; a type-rule and type for closing and breaking the circuit, resting on an endless band composed of carpet binding, which passed over two wooden rollers moved by a wooden crank, and carried forward by points projecting downwards into the carpet binding; a lever with a small weight on the upper side and a tooth projecting downwards at one end, operated on the type; and a metallic fork, also projecting downwards over the mercury cups, and a short circuit of wire embracing the helices of the electromagnet, connected with the positive and negative poles of the battery, and terminating in the mercury cups."



TWENTY-THREE YEARS. From a Portrait on Ivory by Himself.
FORTY-SIX YEARS. From a Daguerreotype.
SIXTY-EIGHT YEARS. From a Photograph.
SEVENTY-TWO YEARS. From a Photograph.
SEVENTY-FIVE YEARS. From a Photograph.

PORTRAITS OF SAMUEL F. B. MORSE AT VARIOUS AGES.

Morse had no money to pay instrument makers or buy materials to construct his apparatus and he therefore took one of the common wooden frames on which he was accustomed to stretch his canvas for painting pictures and the wooden works of an old Yankee clock and, with his own hands, built up the machine which was to revolutionize the world. The frame is about two and a half feet high and three feet wide. In the centre of the upper rail a light triangular wooden pendulum, 18 inches dong, is pivoted. Its lower end carries the pencil arranged to record the message, in saw-teeth lines, on the strip of paper as it is drawn along by the clock work. Thirteen inches from the upper end of the pendulum an armature, two inches long and one-quarter-inch wide, is fastened opposite the poles of a horseshoe electromagnet. The magnet is three inches long and is wound with No. 18 cotton-wrapped copper wire.

This instrument has generally been regarded more as a curiosity than as a finished invention but it embodies three features of great importance. The port rule, or mechanical transmitting device, which Morse made in the form shown in the diagram printed with this paper and also in a circular form, contains the fundamental principles which have been applied in many fire-alarm, stock reporting and other systems of telegraphy. As a recording telegraph receiver the instrument was simple and practical, and clearly suggests, if it did not absolutely anticipate, some of the chronograph and cable recorders. But the most significant fact in connection with it is that it was, the day that Morse completed it, and is to-day, a perfectly practical sounder, capable of being placed in any telegraph office and used for the regular everyday despatch of business. It works well, without a single change, on a current of one ampere and three volts and, while not as sensitive as some of the modern sounders, and while it can not be worked at the highest speed at which typewriting operators are accustomed to receive, it can still be worked at a rate that would try the ability of many first-class operators.

The second Morse recording instrument in the Museum, in point of date, an illustration of which accompanies this article, was made in Baltimore by Daniel Green, who removed from that city to New York and was well-known as a famous maker of meteorological and other scientific apparatus. The exact date of the production of this instrument has not yet been determined, but the evidence goes to show that it was prior to 1840. It was presented to the Smithsonian Institution, in November, 1897, by the representatives of the Reverend Henry Schieb, whose death occurred a short time before that date. Dr. Schieb was a prominent and highly educated clergyman, pastor of a church and principal of a school in Baltimore and, at an early date, had a telegraph line connecting the two buildings as an aid to the instruction of his pupils. He was an intimate friend of Morse and was greatly interested in the success of his enterprise. The instrument is 16 inches long, six inches wide and 10 inches high. It has a simple arrangement of wooden wheels

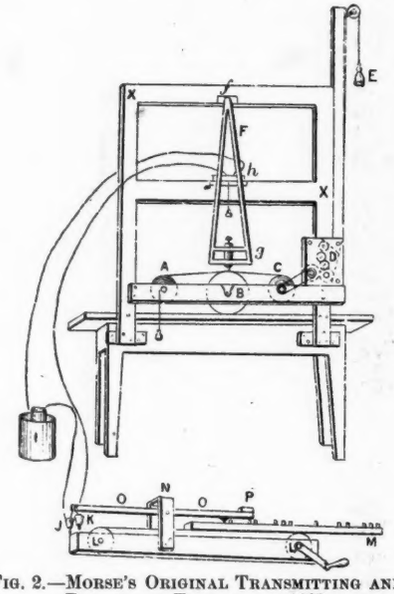


FIG. 2.—MORSE'S ORIGINAL TRANSMITTING AND RECORDING TELEGRAPH, 1837.

and rollers, operated by a weight, for drawing the paper strip under the embossing point at the end of a lever projecting from one end of the armature. The electromagnet, with a core of one piece of iron bent into a horseshoe, stands upright and the armature is pivoted to one of its poles. An interesting point in connection with this machine is the fact that it is made to emboss only one line of Morse characters instead of three, as was done by the register used on the first telegraph line between Washington and Baltimore, in 1844. An original specimen of the record made by the latter, in October, 1844, is in the Museum collections, accompanied with a printed circular signed by Henry J. Rogers, assistant superintendent of United States telegraph, giving the Morse alphabet and explaining that "the telegraph register strikes three copies of each character by means of three points, by which the possibility of failure in any of the characters is avoided, which might occur if a single point was used." These circulars were given to visitors with their names in Morse characters, upon payment of a small fee, and for some time this was the principal source of the company's revenue. The register which was used in the Baltimore office when the line was first opened was in the Museum for several years and is now in Cornell University. A copy of the instrument which was made for exhibition by the government at one or two of the recent expositions now belongs to the Carnegie Institute, in Pittsburgh. This Baltimore register, which, most inappropriately, has come to be called "the Vail Instrument," has been the subject of much discussion and the cause of the publication of many inaccurate statements which should be corrected, but that subject belongs to another chapter in the history of the telegraph. A cut of the machine is given with this paper as a connecting link in the historical line.

At the commencement of the telegraph enterprise, registers, like those referred to, were made by supporting the various parts of the mechanism on separate standards, but it soon became apparent that some improvement in the arrangement was necessary and Morse was obliged to employ skillful mechanicians and clockmakers to do the work. One of the first of these was Dr. J. J. Clark, of Philadelphia, an experienced maker of fine clocks. Mr. Clark devised the plan of setting all the wheels and pinions between two brass plates and, with the cooperation of Morse, Reid and Cornell, produced a very successful instrument which has served as the model for most of the registers made since that time. It was at Clark's shop that J. D. Reid's poetical fancy suggested that the frame of the registers be made in the shape of a harp, a happy conceit which Morse's artistic ability quickly put into a drawing for the mechanician to follow, and the "harp register" was a great favorite with the operators of the time. The series of registers in the Museum includes one used on the Erie & Michigan Line, at South Bend, Ind., in 1848; one from Toledo, 1850; one from Cleveland, 1857; one from Elmira, 1860, and an ink-writing register made by Greeley, in 1891. The series of Morse keys contains the simple straight strip of brass with one end screwed to a block of wood, first used by Morse, and a number of other typical specimens which bring the record down to the present.

There are quite a number of relays of various patterns and dates and a very good type of the Milliken repeater, which was first used at Portland, Me., in 1862. Another interesting object is a small gal-

vanometer, about two inches in diameter, made by Henley, in London, and brought to this country by Professor Morse who presented it to Henry A. Reed in 1855. Reed was then the operator at Poughkeepsie and was an expert at testing telegraph lines by tasting the current. At first he felt very skeptical about the utility of the new device but soon learned to make good use of it. This piece of

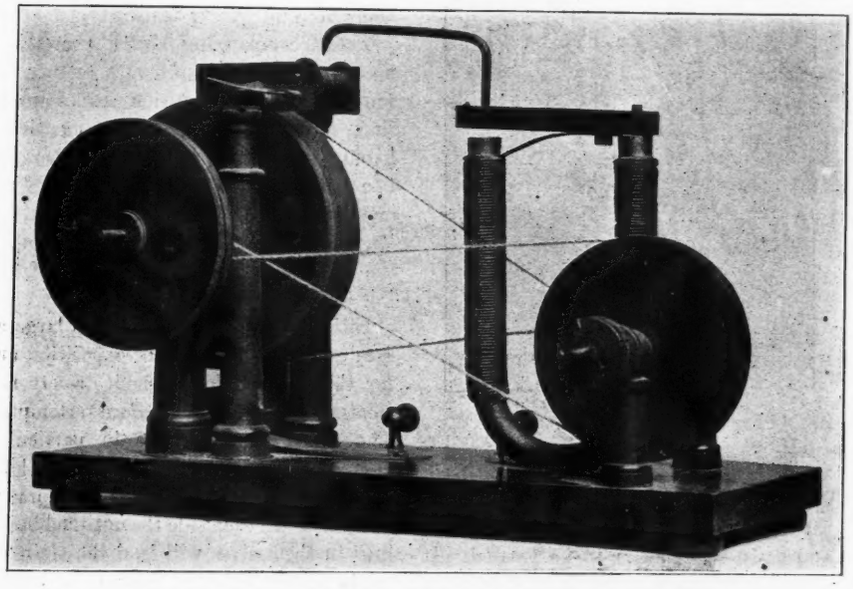


FIG. 3.—MORSE TELEGRAPH RECORDING INSTRUMENT OF 1840.

miniature apparatus is exhibited with a pocket telegraph instrument made at the Caton shops in Ottawa, Ill., and presented to Morse by Judge Caton.

There is also a piece of the original line wire used between Washington and Baltimore, with a certificate written and signed by Tal. P. Shaffner stating that he cut it from the line in October, 1845. It is a No. 16 copper wire covered with a plain cotton wrapping. The wire was clamped at each pole between two pieces of tarred wood set in a short cross-arm.

Among the more personal mementoes of Morse there is an oil portrait painted by Morse's youngest son, Edward Lind Morse, a prominent artist residing in Washington, and a collection of decorations, including the insignia of the French Legion of Honor and other orders conferred on Morse by foreign governments.

Another Morse relic, although not connected with telegraphy, is of interest. It is the camera made by Morse, in 1839, with which he took the first daguerreotypes made in this country. In the early part of that year Morse visited Daguerre in Paris and received directions for the construction of the camera and a promise that he should have instructions for the use of the secret process just so soon as it could be made public. In the following August, immediately after the French government had granted Daguerre a pension for his discovery, Morse received the necessary directions and, having his camera ready, at once commenced work with it. It is now preserved in the Photographic Department of the National Museum.

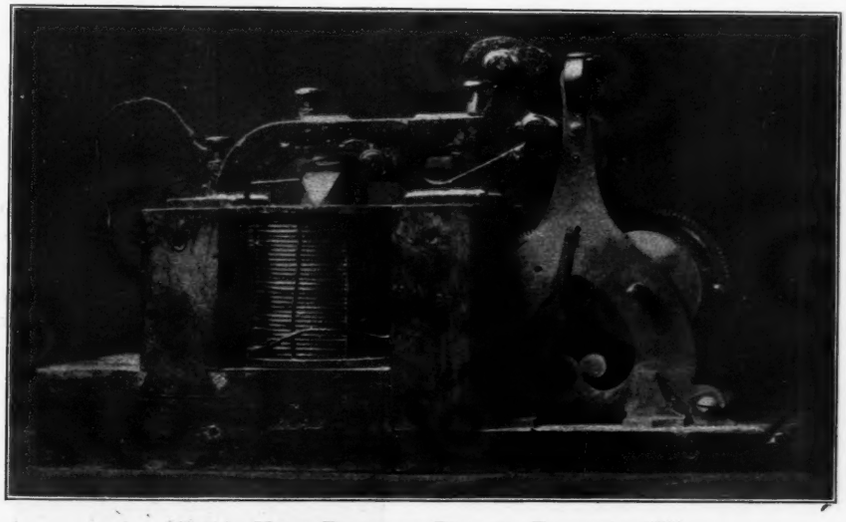


FIG. 4.—MORSE TELEGRAPH REGISTER, BALTIMORE, 1844.

In 1857, when D. Wilmot Smith was superintendent of telegraph of the Michigan Central Railroad, with headquarters at Kalamazoo, the operators in his employ presented him with a set of Morse instruments made with solid silver frames and set with diamonds by Chubbuck, of Utica, and about the same time Judge J. D. Caton presented Smith with a pocket instrument in a mahogany case, which is said to be the first pocket instrument made. When the Prince of Wales visited America, in 1860, Smith was designated to accompany him on his journey from Detroit to Chicago, and he also traveled with Abraham Lincoln on his journey from Springfield, Ill., to his first inauguration at Washington, carrying this instrument on both trips prepared to establish telegraphic communication at any point on the line if occasion required. These instruments form a part of the Museum collections.

Development of Photographic Plates in the Light.

It may be of interest to know that if photographic plates in a camera are greatly over-exposed they may be developed in the light, writes Professor F. E. Nipher, in *Science*. A plate which should for ordinary work have an exposure of a second and a half for street or outdoor photography may be exposed for two hours. When developed with a weak hydrokinone by the light of a lamp, it gives a beautiful positive. The lamp is preferable because one can manage the degree of illumination. If the plate is held too near the lamp it will dissolve a picture already appearing. If held too far away the plate begins to fog. By moving toward or from the lamp the proper illumination may be soon secured. It is remarkable that a street scene taken in this way shows not a moving thing on the streets. Street cars passing every two minutes, wagons, horses, pedestrians, all have apparently vanished without leaving a trace upon the plate. But the fixed objects are shown perfectly, with their proper shadows and high lights. In this way lantern slides and transparencies may be made directly without rephotographing from a negative.

The Rights of the Standee.

A passenger who is standing up in the aisle of a street car can not be compelled by the conductor to move forward unless he is blocking the passageway. This is the law as laid down by Judge Williams, of the Superior Court, at Milwaukee, Wis., in instructions which he gave the jury. The Judge holds that a passenger has the same right to remain in one place when he is standing as if he were occupying a seat. It is the persons who last board the car who must adapt themselves to the crowded condition and find and fill the vacant place.

"I am inclined to the opinion," said Judge Williams, just after directing a verdict for the plaintiff, " that the law upholds a passenger who has accepted standing room in keeping it the same as a passenger who has taken a seat." He then explained that a conductor could not ask a person who was sitting to get up and go to another seat against the passenger's wishes, it being, he said, one of the common rights of passengers.

"The man paid his fare and thus became a passenger," said the Judge, when beginning to give his instructions to the jury, "and under ordinary circumstances would be a passenger until carried to the point of destination.

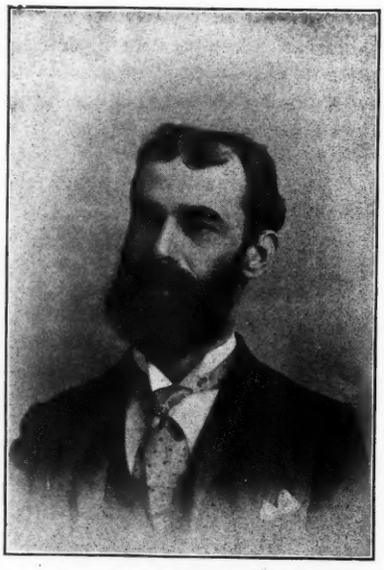
"The conductor put the plaintiff off the car before he had reached his destination because he refused to 'move up' as requested. The defendant's obligation to the plaintiff was to carry him safely and promptly, and the law holds the defendant responsible for the manner in which it executes its duty. The passenger is to be protected from the violence of any agents and the company is liable for damages for such an assault when unprovoked.

"In this case the request was not attended by any voluntary movement forward in the three-foot aisle by any of the standing passengers. The request was mandatory, but no more pressing upon him to move up than upon the passengers who boarded the car later or last, and would be expected to adapt themselves to the congested space instead of the passenger who had acquired rights."

The Michigan Telephone Company, in connection with the American Telephone and Telegraph Company, celebrated, on May 9, the opening of the new long-distance lines connecting Marquette, Mich., with the principal cities of the United States. A reception was held in the evening and a musical entertainment by telephone was given.

The Pan-American Exposition, Electrical and Fountain Effects.

The electrical and fountain features of the Pan-American Exposition, as planned



MR. LUTHER STIERINGER, CONSULTING ELECTRICAL ENGINEER, PAN-AMERICAN EXPOSITION.

by the Mechanical and Electrical Bureau, have been designed with reference to the unusually large areas to be treated. It should be borne in mind that while there have been many expositions held in Europe

MR. HENRY RUSTIN, CHIEF OF THE MECHANICAL AND ELECTRICAL BUREAU, PAN-AMERICAN EXPOSITION.

and the United States, only a few of them were arranged in the grouping of buildings so as to form what may be distinctively called court settings; that is, that while the general treatment of the whole grounds was one of embellishment, an extra effort was made to arrange the buildings and architecture in a particular portion of the grounds so as to delight the eye with an exceptional vista.

Among the expositions which have excelled in this manner may be mentioned the Paris Exposition, 1889; the World's Fair, and the Trans-Mississippi Exposition. In each of these expositions the court setting lent itself to effective decorative lighting at night and each exposition excelled its predecessor in arrangement of the lighting features.

The accompanying sketch shows how much greater area of court setting the Pan-American Exposition contemplates than any of the expositions mentioned heretofore. It will be seen that there are two courts at right angles to each other, one of which, the Court of Fountains, has its axis north and south, while the other, the Esplanade, joins it on the south, forming an inverted T.

Either of these courts have as large an area as that of any former exposition and for this reason alone permit a superior treatment to any heretofore attempted. The Court of Fountains in particular, having its setting climaxed by the lofty Electric Tower at one end, will command attention. On each side the outlined buildings in themselves will lead the sight directly to the towering gem of illumination which will have at its base a solid panel of illuminated vari-colored spray 60 feet in height. The tower rises 350 feet from the basin in which it rests. In the foreground of the tower, and adding to its splendor, will be seen a water display designed expressly for the location with which will be blended an illumination only possible in a territory close to Niagara Falls.

As if to introduce so grand a sight in fountain displays, the Court of Fountains basin has been treated with a view to bringing out special designs in jets of water, not, however, thrown to such height as to curtain the vista from the main approach. Because of the great expanse of water in the Court of Fountains basin, it was found that the inky blackness, so common to exposition lagoons, had to be overcome by an arrangement, in special design, of floating lights which will create a luminous lake of golden fluid and will be agitated by the many fountain jets.

The treatment of the court called the Esplanade adds a pleasing variety to the lighting and fountain scheme, for in addition to the outlining of buildings with decorative lights, from the Government Building on the east end to the Horticultural Building on the west extremity of

this court, there are two large structural cascade fountains. These are axially situated in front of the Government Building and the Horticultural Building, respectively, and from a surrounding of allegorical statuary there will flow a mammoth cascade down a terrace threaded with beds of luxuriant gardening flora and paths. Each of these cascades will be accentuated and colored with light during the night illuminations, which will be specially attractive from the fact that, being in a depression, a plain view may be obtained from any quarter. It should be here noted that in the vistas of these courts, all the display features in lighting or hydraulics are not of spectacular type in the sense that the ordinary electric fountain is. Such fountains can only be effectively operated at certain set periods, and all surrounding lights must be dimmed to permit their successful action, and no such feature could be permitted in vistas where the aim must be to produce a set picture.

The lighting and hydraulic display features of the Pan-American are intended to be a special embellishment to decorate a beautiful picture, not to compete with it, hence the display will be continuous during the exposition hours permitting it.

The ELECTRICAL REVIEW presents herewith portraits of Mr. Luther Stieringer, consulting electrical engineer, and Mr. Henry Rustin, chief of the mechanical and electrical bureau, who have this work in charge, and whose successes at other expositions warrant the prediction that something exceptional may be expected.

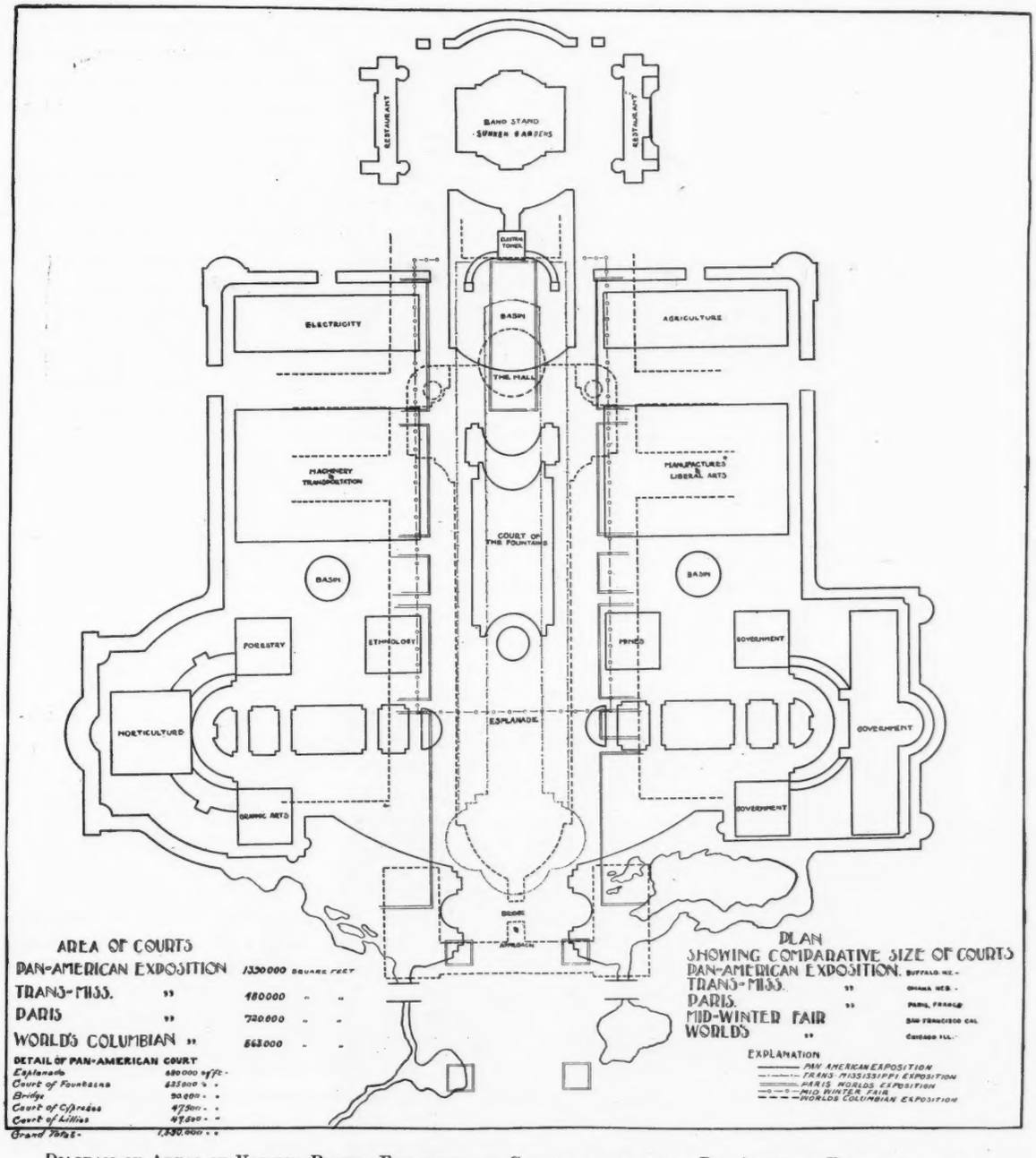


DIAGRAM OF AREAS OF VARIOUS RECENT EXPOSITIONS IN COMPARISON WITH THE PAN-AMERICAN EXPOSITION, TO BE HELD AT BUFFALO, N. Y., IN 1901.

The Akron Automobile Company, 111 Viaduct, Akron, Ohio, has been formed to manufacture electromobiles, especially police patrol wagons and fire department apparatus.

ARRANGEMENT OF INCANDESCENT STREET LAMPS.

BY ALTON D. ADAMS.

Street lighting by incandescent electric lamps has not yet received the attention it deserves. In many towns and cities where arc lamps are extensively used for street illumination, incandescent street lighting has either been entirely neglected or applied to only a slight extent, and even that in an unsatisfactory manner. The general impression that arc lamps are much superior to the incandescent for street lighting is largely due to the manner in which the latter have been arranged and to the quality of the lamps used. As a rule, where incandescent street lamps have been adopted, they have been treated as mere supplements to the arc service, rather than in a manner to make a fair comparison between the two kinds of light possible. The contrast between a 25-candle-power short-filament, incandescent lamp and an electric arc that consumes 500 watts is so great that few stop to consider what the result might be if enough high-voltage incandescent lamps were grouped together to require an equal rate of energy consumption. The more common methods of operation for incandescent lamps in street lighting are in series on arc circuits and in multiples of series from alternating-current dynamos. These systems of connection are adopted in order to cover the long distances over which street lamps must be distributed, with a moderate outlay of conductors. As the general idea, in most incandescent street lighting, has been to locate only one lamp, and that of only 25 or 32 nominal candle-power, at each point, each lamp may consume only a comparatively small amount of energy, say at the rate of 75 to 100 watts. So low a watt consumption requires either a very small number of amperes or a low voltage at each lamp. For the common series circuits, as used in arc lighting, the current is fixed, usually from six to ten amperes, by the requirements of arc lamps, and the incandescent lamps on such circuits therefore require 10 to 15 volts each. To save in the cost of conductors and avoid their multiplication, it is necessary, where series of incandescent street lamps are connected to alternating-current dynamos, that these lamps also have a comparatively low voltage and high ampere capacity. The result of these conditions and of the requirement for as many lamps as possible in each series has resulted in the general adoption of lamps with short, thick filaments in most places where incandescent electric street lighting is in use. Aside from any questions of nominal candle-power, it is a matter of general observation that short filament lamps do not give as satisfactory effects in illumination as are obtained from lamps of much higher voltage and longer filaments. From a structural point of view, as to distribution lines, the series system of incandescent street lighting is not very satisfactory, even with the low voltage common at each lamp. The number of lamps on a single circuit is necessarily small; for 10-volt lamps, 100 on a 1,000 or 200 on a 2,000-volt circuit, and this means a large number of lines of small wire, where any great amount of lighting is to be done. Unless these lines are all returned to the generating station, as they must be when operated from arc dynamos, the current in each can not be regulated. The necessity for current regulation arises from the breakage of lamps or slightly different numbers on circuits attached to one machine and subject, therefore, to the same voltage. As the base or socket of a series lamp is usually provided with means to close the circuit when the lamp filament breaks, a circuit without means of regulation is liable to a dangerous increase of current, though all of its lamps, because of lowered resistance when a number are broken. If incandescent electric street lighting is applied on a really large scale, it seems that the great multiplication of circuits on the series system, and their regulation, becomes a serious matter. The operation of incandescent lamps on series arc circuits, like the operation of such arcs, is open to the objection that a comparatively large number of special machines having a low efficiency and requiring large floor space per unit of output, are necessary for the purpose. Where series incandescent service is taken from standard alternating dynamos, the multiplication of circuits and their regulating devices is far from satisfactory. The worst feature of series incandescent lighting, however, is the inferior illuminating effect obtained with the short, low-voltage filaments. Now, the facts are that street lighting can be done with incandescent lamps in an eminently satisfactory and economical manner, both as to illuminating effects and station operation as well as to the number and arrangement of circuits. Such results can not, however, be attained by the ordinary methods of series distribution, but must usually be reached by constant-pressure service to groups of two or more lamps. General adoption of series distribution for incandescent street lamps has been largely due to the necessity for high pressures, to cover the required areas, and with the ordinary scattered arrangement of such lamps constant pressure supply is less readily carried out. It is now time to put electric incandescent street lighting in its rightful position before the public lest the general impression that incandescent gas lamps are the only satisfactory alternative to electric arcs, gain further ground. Certain objections to arc lighting are well understood, the variations of the illuminating effects between lamps as usually spaced, and the comparatively high costs of operation are urged by those opposed to the system. Incandescent lamp service can readily be rendered that will largely avoid these disadvantages, if lamps are operated in groups. Let four or five 16-candle-power lamps be grouped under a suitable reflector, such groups arranged every half-block in business streets, and a pleasing illuminating effect will be produced. For streets that require a less amount of light, the lamps may be arranged in pairs and spaced the same as before. Each group of two, four or five lamps should have its individual lamps connected in series, but no device should be provided to close the group circuit when one lamp gives out, as this would destroy the remainder of the group on a constant-pressure system of supply. Only a small amount of attention will be required to replace burned-out lamps, much less than is now necessary for arc lamp carbons. Incandescent lamps used in these groups should be of the high-pressure, long-filament type, each for either 110 to 125 or 220 to 250 volts. Such groups of lamps, requiring about 500 or 1,000 volts each, permit distribution at constant pressures of about these figures, and avoid any requirement for series operation or special regulating devices. A pressure of either 500 or 1,000 volts should be employed for incandescent street lighting, according to the distances to be covered by the service. For groups of four lamps each, the 500-volt pressure requires a lamp voltage of 125, and the 1,000-volt distribution a voltage of 250 at each lamp. In places where two-lamp groups are used, either the 500-volt pressure must be adopted for the distribution, or else a third wire must be used to connect each two groups in series, if 1,000 volts are required on the lines. There is no serious objection to this third-wire connection between each two groups, if the conditions warrant 1,000 volts for distribution lines. In those exceptional cases where 1,000 volts would be too low a pressure to insure a reasonable economy of copper, any desired voltage may be generated at the station and reduced at

suitable points throughout the system to either 500 or 1,000 volts by transformers. Such arrangements of incandescent street lamps would be much superior to the present series systems in several ways. Incandescent lighting would come into favorable comparison with that from arcs for out-of-door illumination, instead of creating its present poor impression. Any degree of illumination and any distribution of light desired would readily be obtained. The long-filament lamp, the highest product of its makers' art, would prove as superior for street lighting by incandescence, as it has for indoor use. Any amount of street lighting could be done without the great multiplication of small wire circuits inherent in the series system. The generating plant would share in the general improvement incident to the change from low to high volt street lamps. Inefficient arc dynamos would no longer have a part of their capacity taken up by incandescent circuits, nor would an extensive switchboard and regulating devices be necessary for a large number of series lines. Large standard direct or alternating-current dynamos, such as were regularly used on power and incandescent lamp loads would also be available for street lighting.

The Federal Telephone Company, Pittsburgh, Pa., announces in attractive circulars that on or before July 1, 1900, Federal telephone service will be in operation throughout the country surrounding Pittsburgh, including 40 cities, towns or boroughs. The company has also applied for franchise rights in 32 other places and as rapidly as each franchise is secured will commence to build lines. Mr. Fred De Land, well-known to the electrical fraternity, is president of the Federal Telephone Company.

A New Type of Trolley-Wire Hanger.

In the illustrations herewith are shown in detail the parts of the Faulkner type of trolley ear, which is manufactured by the Ohio Electric Specialty Manufacturing Company, of Troy, Ohio, and which differs radically from any other type of ear on the market, in that it completely surrounds the trolley wire. This, naturally, gives a positive grip on the wire. At the same time, the lower jaw of the ear is ground very fine so as to present but a slight obstruction to the trolley wheel. The thickness of the lower jaw at the centre is one-sixteenth inch, and this gradually tapers toward each end. Each part is made of tough bronze metal and will wear, it is said, for a long time. Each casting is also ground to gauge, making all parts interchangeable and insuring a good fit for the trolley wire.

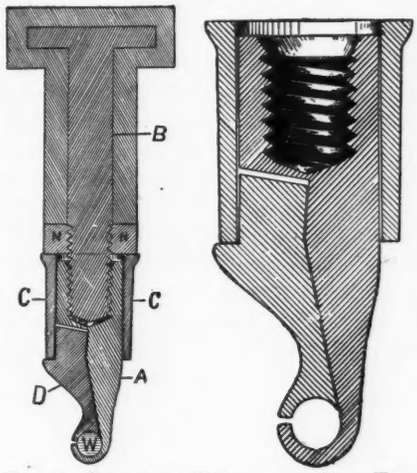


FIG. 3.—SECTIONAL VIEWS OF A NEW TYPE OF TROLLEY-WIRE HANGER.

The method of attaching the jaws to the bell insulator is also novel and is shown in Fig. 3. This illustrates the method of attachment to an ordinary type of insulated bolt, having a nut at the bottom of the insulation. The rigid wire suspending jaw *A* and the removable jaw *D* are first placed around the wire. The collar *C* is slipped over them and the insulated bolt *B* is then rotated. This forces the sleeve *C* down and the result of this is to draw the parts *A* and *D* together so as to clamp the wire *W* firmly between the jaws. The arrangement, as shown, is for use with an insulator employing an insulated bolt, but, of course, the application is just as easy to a regular cap and cone style of hanger. The standard length of the Faulkner ear is six inches and the height is two and one-half inches.

The special claims made for this ear are that it can be placed on the wire or taken off in less than two minutes; it requires no tools to place the ear on the line and no solder is used; in case the stud of the hanger breaks, the ear immediately detaches itself from the wire, leaving nothing to catch the trolley wheel, thereby eliminating any possible destruction to the span wire, trolley wire or trolley pole by reason of the ear remaining attached to the wire; it presents very slight obstruction to the trolley wheel and arcing is reduced to a minimum; it can be carried on cars and placed on wire by the motorman or conductor without delay in traffic, saving many trips for the construction car; it rarely gets loose, but has a tendency to tighten the longer it is on the wire; it can be readily adjusted or moved along the wire and new wire can be strung with great advantage; it can be used on curves as well as on straight line; it can be used with all styles of hangers having an insulated bolt or stud projecting from insulation and is made for any size wire or hanger stud; only one part of this ear wears out and this part can be replaced, as all parts are interchangeable.

FIG. 2.—PARTS OF A NEW TYPE OF TROLLEY-WIRE HANGER.

FIG. 1.—A NEW TYPE OF TROLLEY-WIRE HANGER.

SYRACUSE, N. Y.—The Syracuse & South Bay Railroad Company has been incorporated to build an electric road 12 miles long from Syracuse to South Bay road, on the southern shore of Oneida Lake. The capital is $120,000, and the directors are: Geo. D. Chapman, James E. Ratchford, Hiram W. Plumb, of Syracuse; George R. Allen, of Cicero, and others.

Westinghouse Electrical Apparatus for Paris.

La Société Industriellé d'Electricite, Procédés Westinghouse, of Paris, whose factory is at Havre, is about to erect and equip an immense central power station to supply the surface railroads, known as Les Lignes de Penetration de Paris, which radiate over the main streets and boulevards of the city and suburban districts. The general plan for the distribution of electrical current is, in many respects, similar to that adopted in the three large power stations now being equipped by the Westinghouse interests, in New York. There will be 11 large, direct-coupled generating units, of the revolving field type, supplying current at a high voltage, which will be transmitted to nine substations in different parts of the city, each of which will be equipped with transformers for lowering the voltage, and rotary converters for feeding the lines. A large number of cars will be equipped with Westinghouse motors of 30 horsepower each. The central station switchboard will be of very elaborate character and contain all the latest devices.

The new underground railway, in Paris, known as the Metropolitan, which carries passengers from the northern part of the city to the exposition grounds, is operated electrically, the current being supplied by a Westinghouse 800-kilowatt generator, and the locomotives are driven by Westinghouse motors.

A large power station has been equipped for the Chemin de Fer de l'Ouest, at Moulineaux, half way between Paris and Versailles. This railway, which is the trunk line running through the west of France, is abandoning its steam locomotives on its immense suburban traffic between Paris and Versailles, and is substituting electric locomotives of 400 horsepower. This is the most important departure of this kind on the part of any steam railway in any country in the world. The central station, at Moulineaux, is equipped with six 800-kilowatt, three-phase generators of the revolving field type, supplying current at 5,000 volts. The generators are engine type, direct-connected to Corliss engines built in France, working at 80 revolutions per minute, and are capable of producing a maximum output of 10,000 horse-power. In addition to the current supplied for operating the trains on the lines of the Chemin de Fer de l'Ouest, the Moulineaux station, during the period of the exposition, will supply power to the Westinghouse pavilion in the exposition ground, which will be applied to operating the elevated railroad and the two moving sidewalks, each of which is three miles long, encircling the exposition grounds on the south side of the Seine. The current is transmitted from Moulineaux to the exposition by underground cables at 5,000 volts.

The Westinghouse Company has no exhibit in the electrical building common to the various nations, but has a separate pavilion of its own in the exhibition grounds, at the corner of the Quai d'Orsay and the Avenue de la Bourdonnais, near the Eiffel Tower. In place of a mere exhibition of apparatus set up to entertain sightseers, the Westinghouse building will be a power station in practical operation, equipped with electrical machinery of the most modern description, furnishing electric current for many purposes throughout the exposition. This exhibit includes two 850 horse-power type "C" induction motors, direct-connected to two 600-kilowatt direct-current generators, which supply current for 150 direct-current motors, series wound, each one of about five horsepower capacity. There are, in addition, the necessary tranformers, exciters and switchboard. The two 850 horse-power type "C" motors are the largest polyphase motors ever constructed, and are wound for a 5,000-volt potential, three-phase, which they receive from the Moulineaux station. The two 600-kilowatt direct-current generators, driven by the 850 horsepower induction motors, have a full load rating of 550 volts and 1,090 amperes, operating at a speed of 290 revolutions per minute. The 150 five horse-power motors, which directly operate the sidewalks, are wound for 500 volts.

The electric railway and the moving sidewalk provide means for transportation through the exposition grounds for visitors. These follow a route covering the principal points of the exposition grounds. They pass by the Esplanade des Invalides, Quai d'Orsay and the Champ des Mars, returning to the former by the Avenue de la Motte Picquet, forming a closed circle with a total length of 3,500 metres. The platform is reached by about 12 stations situated within the grounds. The moving sidewalk is upheld by a stout framework of timber, it is composed of two parts, running side by side, the high speed moving at eight kilometres an hour and the other at four kilometres. Passengers can go easily from the fixed platform to the first moving one and then to the second. The platform is made in sections which dovetail one into the other, making a kind of hinge, which enables the curves to be rounded. Under the centre of each platform for its entire length is a stout iron beam which rolls upon a series of wheels placed beneath at intervals, which are the means of carrying it along. The horizontal position is maintained by a smaller rail at each side running upon a set of rollers. Movement is given to the platform by the electric motors, each of which turns a shaft by intermediate gearing; these shafts run under both platforms and have rollers upon which rest each of the central rails. The difference of the speed of the sidewalks is caused by one set of rollers being double the diameter of the other. The adhesion caused by the weight of the platform is sufficient to insure its movement. The electric railway follows the same general route as the moving sidewalk, but passes some times overhead and, at others, in cuttings. It has a gauge of one metre. A series of staircases give access to the stations, which are built on platforms, and electric elevators are also provided at certain points. The trains are scheduled to run at 17 kilometres an hour, with a headway of 90 seconds, making 40 trains an hour. Each train will consist of one motor car and two trailers, having a total seating capacity of 206 passengers per train. The motor cars carry Westinghouse railway motors of 30 horsepower. The current is applied by the third-rail system, which is furnished by the Molineaux station, transformed at a sub-station near the exposition grounds by transformers and rotary converters.

J. H. Bunnell & Company.

The house of J. H. Bunnell & Company, for several years located at 76 Cortlandt street, New York, opened its new and much more extensive offices at 20 Park Place, on May 1. The entire building is devoted to the use of this company, which is one of the oldest manufacturers and dealers in electrical supplies in the United States. The new location is a very desirable one within a few doors of Broadway, and within a step or two of the New York post office. The house, as is well known, makes a specialty of telegraph, telephone, railway and electric lighting supplies, and always carries a large stock of all classes of electrical instruments, batteries, insulated wires and equipments. The company is under the general management of Mr. Charles McLaughlin, who, with Mr. Jesse H. Bunnell comprised the firm until Mr. Bunnell's death. Mr. McLaughlin is widely known in the electrical field, and this evidence of prosperity on the part of his house will be pleasing information to the host of patrons of his company.

A Handsome Power Switchboard.

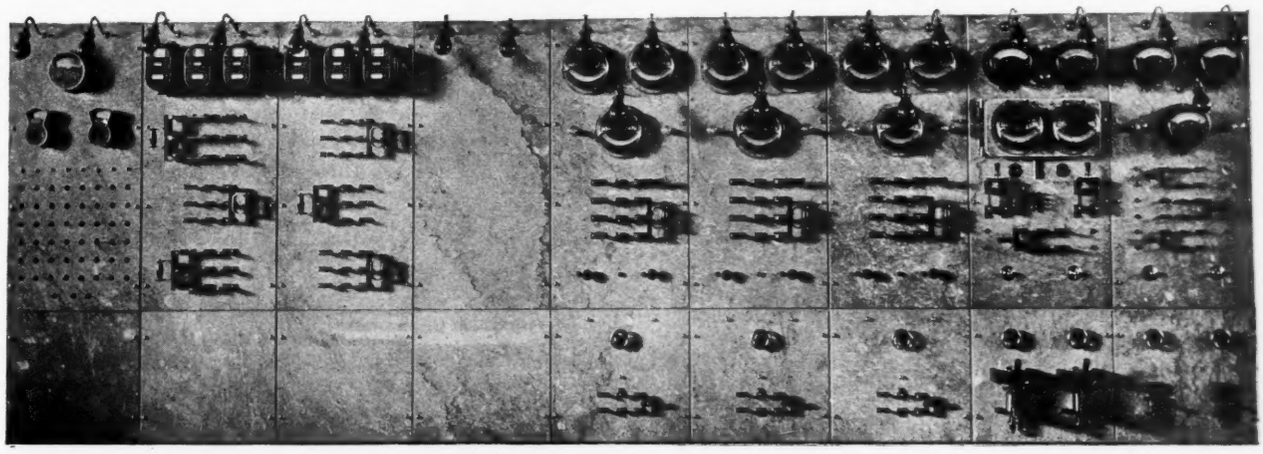
The accompanying illustration shows a switchboard recently built by the Fort Wayne Electric Works for the Pennsylvania Railroad Company and installed in the new electric plant for their Fort Wayne shops. The board, which is 22½ feet long and 7½ feet high, is made of blue Vermont marble, two inches thick, and consists of nine panels supported by an angle iron frame. The angle irons are bolted at the bottom to a six-inch channel, which rests on a brick foundation, and are fastened at the top to wrought-iron braces running to the wall. The switchboard is designed to provide control for two shunt wound direct-connected 15 kilowatt, 110-volt exciter dynamos, three 100-kilowatt three-phase, 220-volt direct-connected alternators, and four constant-current series arc dynamos. The first two panels at the right are for the exciter dynamos. Panel 1 contains two round pattern ammeters, a voltmeter, battery pilot lamps, ground detector lamps, three double-pole, double-throw General Incandescent Arc Light Company's low-tension switches with fuse terminals on the back of the board, two ammeter switches, two battery line rheostats mounted on the back of the board, and two underload circuit breakers for storage battery circuits. The switches are arranged so that either dynamo can operate the constant potential arc circuit, the storage batteries and the telegraph dynamo circuit. On the back of this panel are mounted three Thomson recording wattmeters.

Panel 2 contains two ammeters, a swinging panel containing two Wood alternating current voltmeters, which can be put on any of the alternating-current generators by means of a voltmeter switch; two ground detector push buttons, with alternating-current and direct-current ground detector lamps; flush switch for station lights; one four-pole double-throw voltmeter reversing switch; one voltmeter switch and one ammeter switch; two double-pole, single-throw exciter dynamo switches; one double-pole double-throw generator field switch, with fuse terminals on the back of the board, arranged so that either dynamo can excite the alternating-current generator fields; two automatic overload circuit breakers for the exciter dynamos, and two exciter field rheostats, mounted on the back of the board.

Panels 3, 4 and 5 are for the three 100-kilowatt, three-phase alternators, and Panel 6 is left blank for an additional alternator to be installed in the future. Each of these panels contains three Wood alternating-current ammeters; synchronizing lamps; triple-pole, double-throw generator switch and single-pole, double-throw neutral switch; synchronizing plug switch and generator field plug switches; generator field rheostat mounted on back of board and one double-pole, double-throw equalizer-switch.

Panels 7 and 8 are the feeder panels for the alternating current dynamos and contain six Westinghouse three-phase wattmeters and six triple-pole, double-throw switches for the control of the lighting and power circuits.

Panel 9 is for the constant-current series arc dynamos. It contains a Whitney high-range voltmeter, two Whitney arc ammeters and sockets for four dynamos and four line circuits. There are two sets of bus-bars on the back of the six alternating-current panels, each supported from the switchboard frame by rods which are insulated with porcelain tubes. The feeder switches are so connected that any feeder can be run from either set of bus-bars and one or more alternators can be connected to either set of bars. The fuses for the alternators and feeders are mounted on separate fuse panels fastened to the wall back of the board. All wires enter and leave the board through a wiring trench under the floor back of the board.



SWITCHBOARD IN THE ELECTRIC PLANT AT THE FORT WAYNE, IND., SHOPS OF THE PENNSYLVANIA RAILROAD COMPANY.

Automobiles in War.

A paper on "War and Power Traction," was recently read before the London Automobile Club by the Right Hon. J. H. A. Macdonald, C.B., commanding the Fourth Brigade. The author held that mechanical traction would do much to reduce transport difficulties. In the first place the roads themselves would be cut up less; and, secondly, the same number of wagons would not occupy half as great a length of road as when drawn by animals. In fact, with animal traction, the room required for a team often exceeded that occupied by the wagon drawn. Speeds would be increased by adopting motor cars, so that by an accumulation of the different advantages referred to the total time occupied in the march of a transport train from the start of the first wagon to the arrival of the last might, he thought, be reduced to about one-fifth of that now required.

"Bubbling" in Electromobiles.

[From *London Lightning.*]

The New York ELECTRICAL REVIEW has come out with a special "electromobile number," containing a large assortment of illustrations of electric carriages. It would seem as though these were making rather more headway in the States than here. Also it may be of interest to note that for the moment the correct American for riding in a motor cart is "to go bubbling." This appears to have arisen from the attempts of the American girl to say "automobiling," or even, perhaps, "electromobiling." She is quite right in thinking that time and opportunity are too fleeting for such words.

Mr. Henry L. Shippy's Quarter Centennial.

Twenty-five years is a long period in the lifetime of the average man, and more than suffices to embrace the whole period of his activity and usefulness. In the life of a great industrial art, however, so brief a period is generally inconsiderable, except in the case of electricity and its applications, which it may be said to cover in their entirety.

As has been mentioned before in the ELECTRICAL REVIEW, Mr. Henry L. Shippy was recently—April 12, 1900—tendered a memorial dinner in recognition of the completion of 25 years' service with the house of John A. Roebling's Sons Company, the well-known manufacturer of wire and all the derivatives of wire. At the dinner, given by Mr. F. W. Roebling, a present of a very handsome gold repeater was made by Mr. Roebling to Mr. Shippy, while his associates and old friends who were present united in the presentation to him of a silver loving cup.

The inscription on the loving cup has the names of the donors as follows: Ferdinand W. Roebling, Chas. G. Roebling, H. B. Thayer, A. L. Salt, Alfred F. Moore, James Kempster, J. W. Blackwell, Thomas T. Barr, E. F. C. Young, Sam Rosenstamm, Leonard Lewisohn, Theo. L. Cuyler, Fred Dickson, Richard Stockton, John Robbins, C. R. Bangs, Chas. H. Johnson, R. D. Knight, A. G. Mills, and C. O. Baker, Jr.

There were many brief addresses at the dinner, all of which contained the most sincere congratulations to Mr. Shippy upon the success he had attained.

Mr. Shippy's connection with the electrical field covers the period of its entire development; there was nothing of today's amazing achievement in it even dreamed of when he entered upon active work, the telegraph alone of all the modern electrical applications being fully developed. There was then no telephone, no electric light, no electric railway, no electric motor and no electromobile. There was no commercial use for electricity in those days, save in the telegraph, and it was in the service of that application of electricity that wire found its only usefulness outside of the limited mechanical purposes for which it was manufactured on a comparatively small scale.

It was at this period in the development of the electrical arts, in 1875, that Mr. Shippy, a native of Pennsylvania, became a member of the staff of the John A. Roebling's Sons Company, at Trenton, N. J. Practically little was thought of the electrical uses of wire at the time, as, indeed, practically nothing was known or dreamed of the vast future that awaited electricity and the industries allied with it. Barbed wire for fencing had just been invented, and wire rope had been in use for several years. The suspension bridge, too, had just leaped into great prominence, the bridge at Cincinnati, designed by the late John A. Roebling, having been completed and successfully opened, and the great structure between New York and Brooklyn, the same designer's masterpiece and monument and the foundation of world-wide fame and recognition for its builders, was fairly begun. The New York tower of the bridge had just emerged

MR. HENRY L. SHIPPY.

from the waters of the East River when Mr. Shippy joined forces with its builders.

A year and a half later Mr. Shippy left the works at Trenton and came to the New York offices of the Roebling Company as manager, and ever since has had charge of that important office, extending its commerce to all parts of the globe, until, on June 1, 1899, when the John A. Roebling's Sons Company, of New York, was incorporated, and he was elected treasurer.

During his management he has seen the most remarkable changes wrought by electricity develop themselves. First came the demand for iron and steel wire for telephone use which has since changed to a demand for copper wire, which has so improved and extended the use of the telephone; then came the demand for larger sizes of copper wire for electric lighting, and fast upon the wheels of this another for a wholly novel commodity, insulated wire. At first this new demand was for wires of reasonable size, as sizes of wire were then counted, but the advent of low-tension incandescent lighting increased the size of wires enormously. Then came the high-tension alternating system, again requiring wires of moderate size, but with an insulation far superior to any that had been in use previously. About the same time the growing importance of the telephone so multiplied its lines that cabling was an absolutely necessary resort, and here a new problem was again set for the wire men.

With the electric street railways came further and equally difficult questions of trolley wires, feeder cables and rail bonds. In all these advances the great house of the Roeblings has kept step—often a little ahead of the procession—as is far too well known to require comment. It is interesting to note, however, that while this house, known almost as well for its electrical wires as for its other manufactures and undertakings, has recently celebrated its fiftieth anniversary, less than half of this time has been covered by the period in which its electrical work has been of importance to it. This is because of the youth of the electrical arts. At the same time, Mr. Shippy, who is a young man, has been actively engaged upon the work of the electrical field since its very beginning. His recollections comprise the feeble commencements of the great industries of telephony, lighting, transportation and power generation and utilization of electricity in general. He is to be congratulated no less upon this, and the active share he has had personally in electrical development, than upon the cordiality of his relations with his associates and colleagues as testified by the recently presented tokens of esteem and admiration.

An Electromobile Test.

A new break manufactured by the American Electric Vehicle Company, 134 West Thirty-eighth street, New York city, made a very satisfactory run one evening last week from the company's repository at the above address to the Morris Park race track and return. The break was piloted by Mr. C. E. Corrigan, general manager of the company, and carried three other passengers. While no attempt was made to complete the trip in record time and several visits were made on the journey, the time consumed was a little less than three hours. The total distance traveled was about 25 miles. During the run the vehicle showed its ability to accomplish intervals of high speed with entire comfort.

Some Interesting Arc Lamps.

The "Cosmos" lamp, illustrated herewith, is a new departure in arc lamp construction in that the same general construction is utilized for lamps to be connected in multiple on 110, 220 or 500-volt circuits.

A very noticeable feature of this lamp is the possibility of connecting it directly across the mains of a 500-volt circuit, without a relatively greater steadying resistance than is usually employed in 110 or 220-volt lamps. This 500-volt lamp requires from eight-tenths to one ampere of current, from which it is obvious that no large and wasteful extraneous resistance is used.

Fig. 1 shows an interior lamp with a plain casing, showing the lamp complete for placing on the circuit. The manner of suspending the globe is a very neat and practicable one, as the trimmer has only to raise the two hook handles to clear their catches, when the globe is free to drop as far as the safety chains will allow —entirely out of the way for inserting new carbons, etc. Fig. 3 shows the globe in this lowered position and the trimmer in the act of removing the lower carbon. This figure also shows an ornamental casing instead of the plain one accompanying the lamp illustrated in Fig. 1.

Fig. 2 is an illustration of the interior mechanism of the lamp, only the canopy, or hood, of the previous figures being retained in its covering position From this view one will see the lamp to be of the utmost simplicity in construction. The usual rheostat is shown in the hood, with the controlling switch in position thereon. The flexible cable connection from the magnet to the carbon is also shown, and the clutch and the clutch-stop pan are prominent from their very lack of complication. The clutch pan is adjustable vertically so as easily to admit of arc regulation. The lower carbon holder is also adjustable, and the inner globe holder follows standard practice. The casings may be finished in black enamel, polished brass, oxidized copper, etc.

When used on 110-volt circuits the current ordinarily ranges from four to five amperes; if operating under a potential of 220 volts, the amperes are two to two and one-half. The lamp requires an average of 400 to 500 watts, according to circumstances.

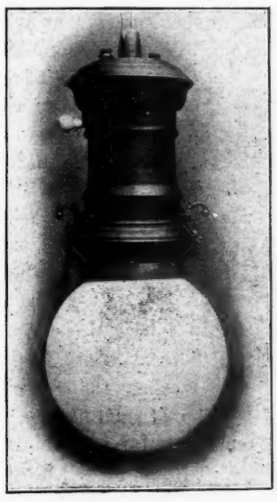
Ample provision is made for ventilation, and in lamps for outdoor service all connections, etc., are constructed to prevent the admission of water to the inside of the lamp. The movable working parts are only the armature and the attached clutch, practically but one moving part. This carries the upper carbon and the clutch lever through which the carbon feed is controlled.

A high degree of economy is claimed to result from the use of "Cosmos" lamps; especially is this said to be the case in using the 500-volt lamp on street railway circuits in comparison with the present wasteful practice due to large extraneous resistances where ordinary single 110 or 220-volt lamps have been tried in series for this peculiarly difficult work. For street railway work, the arc is maintained very stable so that the inherent jarring due to this class of service does not disturb the normal length of the arc, neither is there flickering or "jumping," but a long, steady arc of great illuminating power is held at its predetermined length in a truly remarkable manner. The lamp does not falter, for this class of service, under considerable drop in voltage, and the manufacturers state that the lamp works equally well on suburban lines as on the usually lower voltage city lines.

The special features pointed out in relation to the very exacting service of lamps on 500-volt circuits are special reasons why these lamps lend themselves to the easier conditions found in 110 and 220-volt arc lighting by means of enclosed arcs, on constant potential circuits. They are said to be so marked that there are no noticeable periods of arc readjustment in either the 110 or 220-volt lamps. These lamps are easily adjusted to 100 volts or to 250 and to desirable ranges between.

The superior method of magnet construction and design makes possible the results heretofore mentioned, and with such magnet design the lamp becomes serviceable on circuits of widely varying voltages, thereby opening a field of large dimensions in arc lighting. One hundred and ten-volt lamps operate with an arc of about one and three-eights inches long. All the lamps for the varying voltage operate with enclosed arcs.

The Interstate Electric Company is the sole owner of patents and applications pending on the lamp, which is manufactured by it at its works in Cleveland, Ohio.



FIGS. 1, 2 AND 3.—SOME INTERESTING ARC LAMPS.

BOOK REVIEWS

"Flame, Electricity and the Camera." By George Iles. New York. Doubleday & McClure Company. 1900. Fancy cloth binding. Six by nine inches. 398 pages. 22 plates. 93 illustrations. Supplied by the ELECTRICAL REVIEW at $2.00.

This is a good book for a good boy. It is full of pictures of all manners and kinds of things from bugs to batteries and tadpoles to trolley cars. It is a kind of history of invention and science and its general style of treatment may well be judged from the flamboyant title which it carries. The pictures are good, the printing is fair, but the binding is calculated to keep one awake nights.

"Our New Prosperity." By Ray Stannard Baker. New York. Doubleday & McClure Company. 1900. Cloth. Five by seven and one-half inches. 272 pages. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $1.25.

Some one once said that there are three varieties of lies—lies, ——— lies and statistics. This book consists of statistics. They are illustrated. The work is exceedingly interesting and equally inaccurate, and does not mention the electrical industry, which has shown more symptoms of prosperity than almost any other. While the book is not of value as a contribution to statistical science it makes good reading for Sundays and holidays.

ELECTRICAL CONDUCTORS AND DIRT.*

BY A. A. CAMPBELL SWINTON.

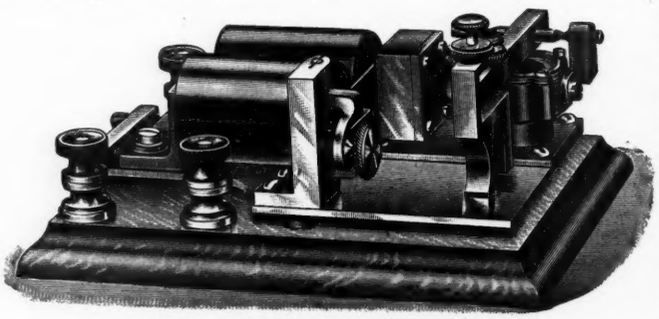
Every one must have noticed how electrical wires and fittings gather dust. Hot-water pipes have a similar tendency, and for a long time I was of the opinion that the action was similar in both cases, and was due to air currents produced by heat. Recently, however, I have had reason to alter my views, and the matter appears to be of sufficient interest for detailed description.

In a new office I have now occupied for five months there are in my own room five plain pendant fittings. As the ceiling is of concrete, and as it was necessary not to disturb the tenant above, these pendants all consist of plain flexible cords of the usual twisted pattern, which start from ceiling roses on the wall near the cornice, and are led through insulated eyes across the ceiling to the points from which they hang. The supply is the continuous-current supply of the Westminster Company at 200 volts. Three of the pendants are upon one switch, the two others being upon another switch. Of the set of three, two are of 16 candle-power and one of 32 candle-power. I mention this latter fact, though it has nothing to do with the phenomenon observed. All the lights are in practice used at once, so that in this respect the conditions are the same in each case. The following, however, are the results, which are sufficiently remarkable to deserve notice.

Within a week or two of my entering into occupation of the office and using the lights it was observed that, whereas the three flexible cords connected with one switch remained clean, the two cords on the other switch were rapidly accumulating dust. The latter were repeatedly dusted, but the effect always repeated itself. At present, after some five months use, while the one set of three cords are still comparatively clean, never having been dusted, the other set of two cords are thickly covered with an aggregate of dust particles, which in some places project fully one-quarter of an inch from the cord. Further, while the plaster of the ceiling in the case of the set of three cords is absolutely white, and the ceiling roses at the ends of these cords retain their original color, the ceiling immediately above the set of two cords is blackened with a well-defined, broad, dark line, while the ceiling roses that serve these two cords are also covered all over with a dark deposit.

Now for the reason of this strange phenomenon. It is very simple. In the case of the set of three pendants, the flexible cords and ceiling roses of which do not become dirty, the switch is in the positive pole. In the case of the other set of pendants, whose cords and roses become covered with dust, and which even blacken the ceiling, with which they are not in contact, the switch is in the negative pole. Now, as is well known, the negative conductor in the street mains has a tendency to earth itself to an extent which is sufficient to cause the negative lead to be always almost at the same potential as earth. Consequently, the positive conductor is always at nearly 200 volts potential above that of earth, and therefore above that of the dust particles present in the atmosphere. This point has been tested in my office with a voltmeter, with the results that from the negative there are only about 30 volts to earth, while from the positive there are 170 volts to earth. The reason for the effects observed is thus obvious. In the case of the three pendants, whose switch is in the positive, it is only when the switch is turned on a few hours per diem out of the 24 that there is any appreciable difference of potential between the cord and the surroundings. Even then it is only one conductor in the cord that has this potential, and the exterior of the covering very possibly always retains zero potential. In the case of the other set of two lamps, whose switch is in the negative, the result is far different. When the switch of this set is turned on, no doubt the conditions are similar to the other set when the latter's switch is also turned on. But during the many hours every day when the switch is turned off, in the case of the two light set, both of the conductors remain constantly at a potential 170 volts above that of its vicinity. The dust is therefore caused to deposit upon the cord and upon the ceiling rose by electrostatic attraction. No doubt the use of 200 volts, which will give four times the attraction afforded by 100 volts, has made the effect more marked in this particular case.

I should not have thought it worth while bringing the above facts forward publicly had they not been so marked as to be a serious nuisance in the case of the pendants whose switch is in the negative. From the point of view of the wiring of decorated rooms in a town with an atmosphere like London, the matter is of very considerable importance. It will be found that with the switches in the negative, an amount of dirt will be deposited in a few weeks that would take years to accumulate with the switch in the positive. I am well aware that from a totally different point of view, in damp situations, there is an advantage in putting the switch in the negative, for the reason that otherwise the metallic mechanism of the switch is liable to be corroded away by electrolytic action. In dry places, however, where it is desired to keep electrical wires and fittings clean, I have no doubt that in an atmosphere such as we have in this great city, switches should always be placed in the positive conductor, so that the exteriors of such fittings and wires should remain as far as possible at earth potential.



A NEW WIRELESS TELEGRAPH RECEIVER.

A New Wireless Telegraph Receiver.

A new system of wireless telegraphy is before the public and is the outcome of American investigation and experimentation, being claimed to be totally independent of the devices of Marconi and his assistants. As bearing this statement out it is stated that in connection with this receiving instrument there is used but a single dry cell. There are no auxiliary batteries or shunts, no rappers or tappers, no choking coils, and no self-inductances to be overcome by artificial resistances. The coherer is not of the Branly form and there is no induction step-up used in circuit with it.

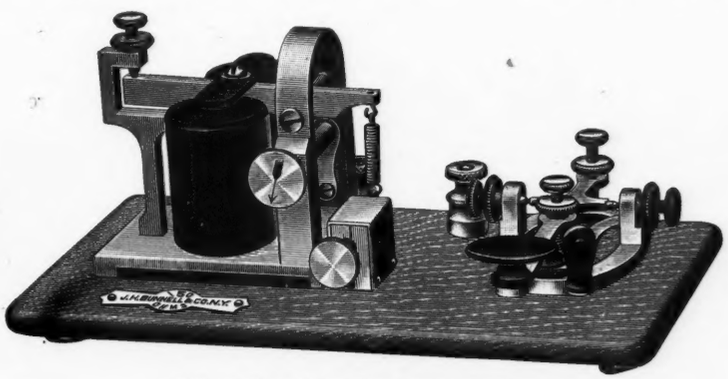
The receiving instrument is extremely sensitive, so much so that it is operative through 14,000 ohms of external resistance (the spools being wound to 1,000 ohms), only one dry cell being used as a generator. This gives 0.00009 ampere. From this it will be seen that the coherer need not be cohered lower than 14,000 ohms to operate the instrument. The illustration shows the use of a sounder, but a register is operated equally well and with no more battery service than the one cell. Masts are now being erected on the west shore of Lake Michigan for stations, some of the masts being in place. The stations are for practical use in connection with lake shipping.

* From the London *Electrician*.

A New Main Line Sounder.

The house of J. H. Bunnell & Company, New York, has recently brought out a greatly improved type of main line sounder that contains several new and desirable features.

It will be seen from the accompanying illustration that the instrument presents a solid, handsome appearance. The notable points of novelty are the instantaneous adjustment of the distance between the armature and the magnet cores, which is accomplished by an eccentric movement operated by the upper adjusting nut, causing the arch in which the armature is pivoted to slide up or down in its guides. The arrow on the adjusting nut indicates at a glance the relative position of armature and magnet. The adjusting nut is also provided with a projection (not shown in cut) by means of which the operator can tell as soon as he takes hold of the adjusting nut which way to move in order to get the desired adjustment.



A New Main Line Telegraph Sounder.

It will be noticed that the screw and the check nut that are ordinarily used on the front end of the armature lever have been dispensed with, simply a steel pin being inserted in lower side of the lever to strike the anvil. When the indicating arrow on the adjusting nut points straight downwards the armature is as close as possible to the magnet cores but they can never come into actual contact.

One of the annoyances of the old form of main line sounder, or relay, was the breaking of the string that was used to vary the tension of the retractile spring of the armature. In the new form the use of string or cord is entirely dispensed with, and a long, quick range of adjustment is secured by means of a cam lever operated by the lower adjusting nut. It will be observed that both adjustments are operated from the front of the instrument, thus making it more convenient to adjust, whether mounted in combination with a key on same base, or separately on table or in resonator box. The instrument has been designated the "M. C. M." (1900) model, and is furnished with either brass or aluminum lever, and with or without key on same base, as desired.

Engineering Lectures at Purdue University.

The non-resident lecture course delivered before the engineering students of Purdue University, Lafayette, Ind., during the current school year, has included lectures by the following gentlemen:

A. V. Abbott, chief engineer of the Chicago Telephone Company, Chicago. "The Construction of Electrical Circuits."

Bion J. Arnold, consulting and designing engineer, Chicago; "The Development of Electrically-Operated Railroad Systems."

A. E. Kennelly, president of the American Institute of Electrical Engineers, Philadelphia; "Ocean Telegraphy."

Martin A. Knapp, chairman Interstate Commerce Commission, Washington; "The Interstate Commerce Laws and Their Relation to the Public."

George B. Leighton, president Los Angeles Terminal Railway, St. Louis; "The Work Ahead."

Calvin W. Rice, electrician for the New York Consolidated Telegraph and Electrical Subway Company, and the New York Gas and Electric Light, Heat and Power Company, New York; "The Development of High-Tension Service."

Charles F. Scott, chief electrician of the Westinghouse Electric and Manufacturing Company, Pittsburgh; "Modern Methods for the Distribution and Long-Distance Transmission of Electric Power."

Walter B. Snow, B. F. Sturtevant Company, Boston; "Heating and Ventilating."

R. H. Soule, Baldwin Locomotive Works, Chicago; "Notes and Suggestions from Experience in the Motive Power Department of Railways."

Henry M. Sperry, Union Switch and Signal Company, New York; "Recent Progress in Block and Interlocking Signaling."

F. H. Newell, hydrographer, United States Geological Survey, Washington, D. C.; "The Hydrographic Work of the United States Geological Survey."

L. A. Downs, roadmaster, Illinois Central Railway, Louisville, Ky.; "Track Work."

Each of these lectures has been delivered especially to the junior and senior students in engineering. Wherever, however, they are of general interest, the freshmen and sophomore students are expected to attend them. This course of lectures, which is given every year by representative men, forms one of the most attractive features to the student of the engineering instruction, and is of special value to them in view of the fact that they come in touch with and have opportunity of studying the personality of men who have become distinguished in their several professions. Such contact is, of necessity, an inspiration to the student. It serves to interest him in his work and inspires him to higher endeavor.

The value of the instruction afforded by the course during the present year has been of an especially high order, as the lecturers have, to an exceptional degree, designed their addresses for the student, speaking to him in the clear and interesting manner which always wins his close attention.

Western Union vs. American Bell.

[From the *Boston News Bureau.*]

That the American Bell Telephone Company is making serious inroads upon the Western Union field is very well understood by the public. There is no dangerous decline in Western Union earnings, but the increase in communication in this country seems to be taken by the Bell people, while the Western Union earnings are very stationary.

There are mutterings that the Western Union Telegraph Company is preparing for a battle with the Bell Telephone lines and it is declared that the Western Union people are well identified with the Telephone, Telegraph and Cable Company of America, which has bought the Erie Telephone Company, and owns several Bell opposition companies.

It is declared in New York that the Western Union is stringing thousands of miles of new copper wires, the expense of which has been paid for out of its recent bond issue. It is declared that when the Telephone, Telegraph and Cable Company of America is ready to fight the Bell people it will be prepared to use Western Union offices in districts where it has no wires of its own.

It is said that the Western Union people have a great grievance against the Bell Company in the leasing of private wires, as the private wire field at one time furnished 30 per cent of the Western Union Company's profits.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

(*Concluded from page 495.*)

tary of all of them, and at one time or another treasurer of most of them. In fact, Mr. Insull really managed the financial side of all the various interests with which Mr. Edison was then identified.

At the end of 1885, he became treasurer and general manager of the Edison Machine Works, moved the business to Schenectady, and with Mr. John Kruesi as his assistant, developed what is now known as the Schenectady Works of the General Electric Company. In 1890, the old Edison interests were consolidated into the Edison General Electric Company, Mr. Insull being made second vice-president. In 1892, this company and the Thomson-Houston Company were consolidated as the General Electric Company, the second vice-presidency of this going also to Mr. Insull. Almost immediately after his election to this office he resigned it, accepting the presidency of the Chicago Edison Company, which he has held ever since.

Alden March Young, twelfth president of the National Electric Light Association, was born at Hadley, Saratoga County, N.Y., September 6, 1853. After leaving school he began work, electrically, in the employment of the Atlantic & Pacific Telegraph Company, being manager for them, in 1870, at Fort Plain, N.Y., and then successively from 1871 to 1878, at Saratoga, Syracuse, Albany, Buffalo and New York city. In 1878, Mr. Young went to Waterbury, Ct., organizing the telephone company there, of which he was the manager for about 10 years, during that time constructing telephone lines for many miles about Waterbury, and establishing exchanges at various points. In 1883, Mr. Young became interested in electric lighting, and a little later, organized in Waterbury its first and only electric lighting company. In 1892, he obtained a controlling interest in the Waterbury Horse Railway Company, and very soon after changed its motive power to electricity. In 1890, taking up the private business of Mr. Young, the New England Engineering Company, of Waterbury, was incorporated, for the purpose of installing electric light plants, electric railways and power stations; by this company, electric light plants were installed at many points. In many electric light, railroad and gas companies, Mr. Young is now interested as stockholder, director or officer. He is at present a director and vice-president of the Kings County Electric Light and Power Company, of Brooklyn, N. Y., which company he organized in 1897, consolidating with it the several electric light companies of Brooklyn. He is treasurer of the Connecticut Lighting and Power Company, which controls the electric light and railroad systems of New Britain, Waterbury and Naugatuck, Ct., the gas and electric light companies of Norwalk, South Norwalk and Greenwich, Ct. He is a director of the Colonial Trust Company, of Waterbury, Ct.; president of the Bridgeport (Ct.) Traction Company, which includes the street railroads of Shelton, Milford, Westport and Saugatuck. He is one of the organizers of the Albany and Hudson Railway and Power Company (covering Hudson, Rensselaer and Niverville, N. Y.), which is about to operate the third rail electric system from Hudson to Albany. He is also a director of the National Carbon Company, of Cleveland.

General Samuel T. Carnes, the thirteenth president of the National Electric Light Association, is one of the prominent citizens of Memphis, Tenn. He was born in Hardeman County, West Tennessee, in 1850. He is one of the best known military tacticians in the country, and his instincts and inclinations are decidedly military. For a long time he was Brigadier-General of the State of Tennessee, and for some years was captain of the Chickasaw Guards of Memphis. This became one of the crack military companies of the United States under his leadership. General Carnes is responsible for the introduction of both the telephone and electric light in the city of Memphis. For years he has been president and general manager of the Memphis Electric Light and Power Company.

The Pacific Electric Company, La Crosse, Wis., are making a new flexible covering for incandescent cord, telephone and electric wires, and also for covering chandeliers. The new covering is known as the "Pacific coverette," and has been favorably passed upon by the Board of Electrical Inspectors.

Some Electrically Heated Utensils.

It was not very many years ago that electric heating and cooking utensils were looked upon somewhat askance. Today they are in evidence everywhere, and everybody knows they have come to stay. So great is the popularity of this style of cooking and warming apparatus that it is necessary constantly to produce new styles to meet the growing demand for them.

The illustrations show some of the recent types of such appliances. Fig. 1 is a broiler, for broiling steaks and chops. It is made entirely of cast-iron, and is therefore easy to keep clean. Fig. 2 is a griddle, for cooking griddle cakes, and is also useful as a stove for heating any vessel that can be placed on the smooth, hot, flat surface. In Fig. 3 is shown a foot warmer, which is an admirable device for applying a little heat just when and where wanted, under desks, typewriters, etc. Figs. 4 and 5 show respectively a tea pot and coffee boiler. All these appliances are made for any ordinary voltage of direct or alternating current, by the United Electric Heating Company, of Detroit, Mich.

FIG. 1.—BROILER.

FIG. 2.—GRIDDLE.

FIG. 3.—FOOT-WARMER.

FIG. 4.—TEA KETTLE.

FIG. 5.—COFFEE POT.

EXAMPLES OF ELECTRICALLY HEATED COOKING UTENSILS.

BUSINESS NOTES.

The Crown Woven Wire Brush Company, of Salem, Mass., is meeting with much success with its new lubricant known under the name of the "Crown" commutator compound. The company claims that this compound is one of the best lubricants on the market for dynamo work and its use is a great saving on the wear of a commutator.

The Frank S. DeRonde Company, Incorporated, 52 and 54 John street, New York city, is handling a white paint for central stations and dynamo rooms, known as "Lythite." It is claimed to be the whitest white made, is fire and weatherproof, and is made in 24 shades. Samples of Lythite as well as a color card may be obtained free on application. The Frank S. DeRonde Company also sells the P. & B. insulating materials. Mr. Frank S. DeRonde, as is well known, was formerly connected with the Standard Paint Company, the manufacturer of the P. & B. compound, and he still represents that company.

Some New Circuit Breakers.

The circuit breaker has long since become a necessary adjunct of the central station, the isolated plant and even the subordinate distributing switchboard. In the illustrations herewith are shown some new types of these instruments adapted

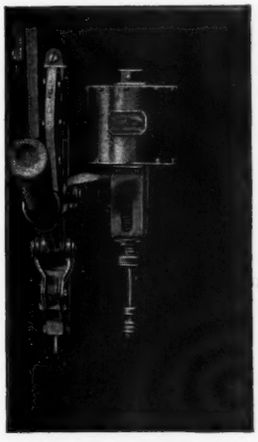


FIG. 1.—SINGLE-POLE ALTERNATING-CURRENT CIRCUIT BREAKER.

for both direct and alternating currents.

Fig. 1 shows a front view, and Fig. 2 a side view, of the single-pole alternating-current circuit breaker, made by the Ward Leonard Electric Company, Bronxville, N. Y. In this instrument all the parts are designed with special reference to the reduction of hysteretic heating to a minimum. The iron is finely laminated and of the softest quality procurable. The illustrations well show the mechanical construction of the instrument.

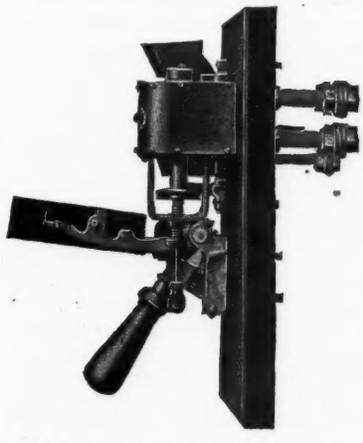


FIG. 2.—SINGLE-POLE ALTERNATING-CURRENT CIRCUIT BREAKER.

In Fig. 3 is shown a very interesting form of circuit breaker for direct current, made by the same company. This instrument is separate closing; that is, each side is closed mechanically independent of the other. The many advantages in the use of such an instrument are obvious from the fact that it dispenses with the necessity of using switches in connection with it and not only economizes space on the switchboard, but is also fool-proof; it can not be closed except for a small fraction of a second on short circuit or overload, for under such conditions when one side is closed as shown in the illustration in Fig. 3, the opposite side will fly open on attempting to close the other side, and *vice versa*.

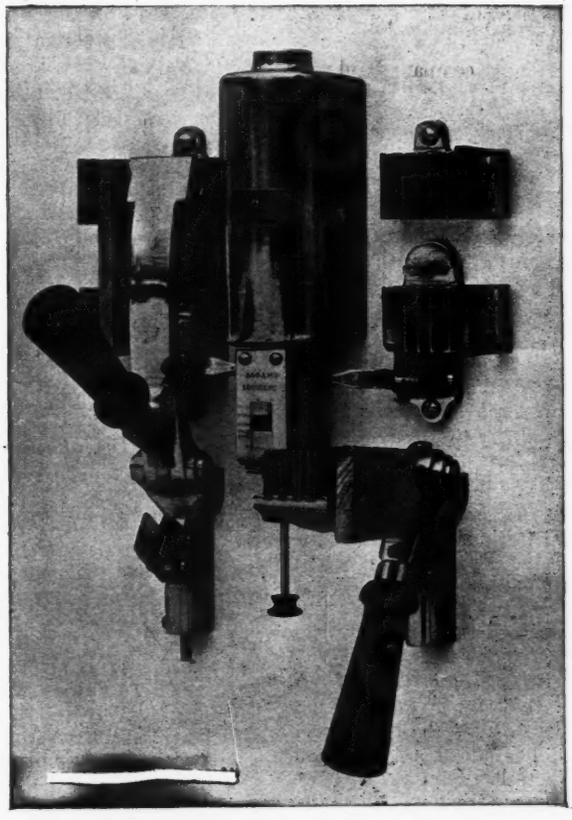


FIG. 3.—DOUBLE-POLE DIRECT-CURRENT CIRCUIT BREAKER.

AUTOMOBILES

It is stated that ex-Queen Liluokalani has bought an automobile and will take it to Hawaii when she returns.

It is said that the present horse cab service now operated in connection with the Waldorf-Astoria Hotel, in New York city, will be replaced by an automobile service.

Captain Homer W. Hedge, secretary of the Automobile Club of America, intends to take up, in the near future, the question of affiliation of clubs in the various cities of the United States.

The Automobile Club of America recently voted to allow 100 more members to join without paying the usual initiation fee. About 25 made application in one day and other applications have been received since.

An Electrical Planked Shad Dinner.

The Electrical Supply Dealers Associations, of New England, New York and Philadelphia, held their meeting in Philadelphia last week, and on May 8 the local association at Philadelphia gave the visiting delegates a very enjoyable planked shad dinner at Washington Park, N. J. The affair was a thoroughly delightful one. The men of science and industry present enjoyed the occasion immensely. The menu, which was printed in the form of a "local sheet" as issued by the supply dealers, is given below, and may be considered a masterpiece on the part of the author:

MENU.

	VEGETABLES.	
	NEW ONIONS (Capacity 1,000 amperes).	"Hully" G
PLANKED SHAD (Bare and hard drawn)	FRESH PEAS (Baby type).	
	BERMUDA POTATOES (Bug cut-out).	
SHAD ROE (Well taped).	TOMATOES, Sliced (Red Core).	
	CUCUMBERS (Slow burning).	
	ASPARAGUS (In standard packages)	Washington Park, N. J.
HOT WAFFLES (Sal-ammoniac dressing).		
ICE CREAM (7-foot spoons).		
	LIQUORS.	
COFFEE (In porous cups).	BEER (50 volts).	
	ALE (75 volts).	
CIGARS (Matchless style lighters).	SAUTERNE (110 volts).	
	OLD RYE (Full 2,000 c.-p.)	
CIGARETTES (Stiff pull).	EXTRA DRY (Sheet canceled).	May 8, 1900.
COME ALONG.	NO DEAD MEN.	

INDUSTRIAL NOTES

L. B. Allen Company, 1335 Columbia Avenue, Chicago, is sole manufacturer of the Allen soldering stick and the Allen soldering salts and reports an active demand for both of these articles.

The Western Electric Company, Chicago, is sending out to the trade a neat eight page bulletin describing the Garton lightning arresters. It is well illustrated and contains a complete price list.

The Fort Wayne Electric Works, Fort Wayne, Ind., has issued Bulletin No. 1,008, illustrating and describing Wood generators of the M. P. type. The Bulletin may be had free on application.

John T. McRoy, New York and Chicago, manufacturer of the well-known McRoy vitrified clay conduits, is out with his calendar blotter for May, containing political maxims as applied to the conduit business.

The Sprague Electric Company, New York city, has recently sold two 200 kilowatt split-pole generators of the belted type to the Benjamin Atha & Illingworth Company for use in their steel works, at Harrison, N. J.

Thompson, Son & Company, 107 Liberty street, New York city, have issued a booklet "bargain sheet" giving details of second-hand machinery they have for sale. All the electrical machines in stock are ready for prompt delivery.

The Electric Appliance Company, Chicago, is inclined to be rather enthusiastic in talking about the line of Dayton fans it has for the season of 1900. It states that they are theoretically, practically, scientifically, electrically and mechanically perfect.

The Chicago General Fixture Company, of 169 Adams street, Chicago, has been compelled to double the capacity of its factory and has added a lot of new machinery. There has been a very large increase in its fixture trade and these improvements were found necessary.

Mathias Klein & Son, Chicago, manufacturers of Klein's climbers and Klein's construction tools, are enjoying an excellent Spring trade. The reputation these articles have long since established has had the effect of building up a large business for the above-named firm.

The Dicke ball-bearing pay-out reel is described in an illustrated circular issued by the Western Electric Company, Chicago and New York. It is designed to be a convenient and handy method of unwinding large coils of wire and its advantages should be highly appreciated by linemen. The ball-bearing feature makes it especially easy in its operation.

Charles Austin Bates, Vanderbilt Building, New York city, the well-known advertising expert, has issued a beautiful booklet, with a cover in colors, illustrating the Charles Austin Bates Building, which is to be erected in Longacre Square, New York city. The building is located at 206 and 208 West Forty-third street, at the corner of Broadway, and its value, with the ground, is $250,000. It is 17 stories high and will be devoted entirely to Mr. Bates's advertising business in all its branches.

The Electrical Engineer Institute of Correspondence Instruction is comfortably located in its new quarters at 240 to 242 West Twenty-third street, New York city. The Institute informs the ELECTRICAL REVIEW that it has now enrolled a large number of students, not only all over the United States, but in nearly every foreign civilized country on the globe. Courses in electrical engineering, mechanical engineering, mechanical drawing, etc., are provided, and are described in circulars which may be obtained free on application.

J. H. Bunnell & Company, who recently removed their well-known electrical supply house from 76 Cortlandt street to 20 Park Place, New York city, are comfortably installed in their new quarters, which present a very attractive appearance. Park Place, being a wide street, gives the firm ample opportunity to tastefully decorate the front of its store. Mr. Charles McLaughlin, the head of the house, has recently returned from a trip to Mexico, and is preparing for an active campaign along the lines which have made the firm of J. H. Bunnell & Company so successful.

The Eureka Electric Company, of Chicago, showing its usual progressive spirit, and to keep in close touch with the independent companies in the east, has opened an office and salesrooms in the Stephenson Block, at Indianapolis, Ind. It has also enlarged its factory at McCordsville, and is now manufacturing some very fine new devices, particularly a new receiver and transmitter, as well as a new desk set. The company's Eureka switchboard, which has won a record, and has met with a very large sale, has several new features embodied in it that will place it still further in advance, so the makers claim.

The J. M. Atkinson Company, 1612 and 1613 Marquette Building, Chicago, has issued a neat circular, printed in colors, describing the numerous electric railway and lighting specialties which it handles. These include the Falk Company's steel gears and pinions, the Sterling Varnish Company's insulating varnish, the Partridge Carbon Company's carbon brushes, protected rail bonds, fuses, switchboards, knife switches, fan motors, etc. The company states that it will be pleased to receive inquiries for anything electrical and will send, on application, a complete electrical catalogue.

The American Electric Telephone Company, Chicago, is just completing the installation of a 600-number switchboard for the Huntington Mutual Telephone Company, at Huntington, W. Va. This board is equipped with the electric lamp transfer system and has an ultimate capacity for 1,000 subscribers. Local service will begin at once. The American Electric Telephone Company has also recently equipped, with its central battery system, the exchanges of the Columbiana County Telephone Company, at Salem and East Liverpool, Ohio. These systems went into commission during April and the excellence of the service is causing many new subscribers to enroll their names.

In one of the shops of the United States Cast Iron Pipe and Foundry Company, Cincinnati, Ohio, the company has fitted up a room with drawing tables, boards and T squares as a study room for the use of a number of its employees who are students of the International Correspondence Schools, Scranton, Pa. The class, which numbers about 50 men and includes the general manager, studies on "company time" and is supplied with drawing paper by the firm. All promotions in the shops will hereafter be made from students of this class. The International Correspondence Schools have nearly a hundred courses treating of all branches of mechanical and engineering work. Instruction is carried on wholly by mail and there are nearly 200,000 students and graduates.

The Mica Insulator Company, the originator and patentee of "Micanite" and "Empire" insulating materials, has experienced a heavy increase in its business. Some of the finest electrical machinery ever manufactured is insulated with "Micanite." The long experience of this concern in this particular line of work enables it to produce what is claimed to be the best segment manufactured. The company has passed beyond the experimental stage in the manufacture of insulation, and electricians and those designing new apparatus will do well to inquire about "Micanite" as an insulation. The Mica Insulator Company's factories are located in Schenectady, N. Y., and Stansted, Essex, England. Mr. Charles W. Jefferson, formerly associated with the General Electric Company, is the company's manager at the Schenectady works. Mr. Fred W. Dwyer, also formerly associated with the General Electric Company, is the manager of the English factory. These two gentlemen possess great ability along this line, and those interested in the designing of new apparatus or in securing a remedy for difficult problems connected with the successful insulation of old machinery are invited to correspond direct with these gentlemen. The company's offices are located in London, England, 12 Camomile street; New York city, 218 Water street; Chicago, 117-119 Lake street. They also have branch offices, with stocks, in the following cities: Cincinnati, under the management of the Monroe Brass and Wire Company; St. Louis, under the management of Arthur S. Partridge; Cleveland, represented by the George Worthington Company; San Francisco, under the management of the Brooks-Follis Electric Company; which enables the company to quickly and easily distribute its materials in the respective territories.

ELECTRICAL PATENTS

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED MAY 8, 1900.

648,919 Electric-telegraph apparatus for use on cable or other lines; S. G. Brown, Bournemouth, England — A tongue arranged in a relay-circuit adapted to be moved by the arrival signaling-currents, a rotary contact in the relay-circuit with which rotary contact the said tongue makes and breaks circuit, and a condenser short-circuiting the contact between the said tongue and rotary contact.

648,939 Electric circuit closer; H. H. Fowler, Waverly, Tenn.

648,951 Electric switch; Aug. Hanson, Chicago, Ill.

648,977 Signal for selective calling appliances; F. R. McBerty, Evanston, Ill.

648,978 Signaling apparatus for telephone-lines; F. R. McBerty, Evanston, Ill.

648,995 Electric-train system; W. B. Potter, Schenectady, N. Y.—A plurality of motor-cars united to form a train, or a portion of a train, a train-wire, means for supplying current thereto, circuit from said train-wire to a plurality of translating devices, and means controlled from a single point for instantaneously interrupting the supply of current to all of said circuits.

649,006 Alternating-current motive apparatus; C. P. Steinmetz, Schenectady, N. Y.—Consists of a primary member having energizing-coils, a secondary member, and a phase-modifying device for reversing the relative phase relation of the currents in the energizing-coils in accordance with changes of frequency in the supply-circuit above and below a certain predetermined value.

649,007 Frequency-indicator; C. P. Steinmetz, Schenectady, N. Y.

649,008 Frequency-indicator; C. P. Steinmetz, Schenectady, N. Y.

649,015 Current-interrupter; Elihu Thomson, Swampscott, Mass.—An element for an automatic current-interrupter, comprising an anode and cathode mounted on a common frame, the former being protected from access of the liquid conductor except at its tip, and means for adjusting it to vary the extent of exposed surface.

649,031 Electro-magnet; S. M. Young, New York, N. Y.

649,068 Spring-jack for telephone-switchboards; F. R. McBerty, Downer's Grove, Ill.

(*Continued on Page 52.*)

A WONDERFUL BICYCLE SALE.

Arrangements have been made whereby one of the largest Bicycle Factories in the United States is going to market their entire output direct to the rider at prices that will astonish you—the lowest prices ever known for standard high-grade, guaranteed wheels and tires. For special prices and most liberal terms mail a postal to the Akron Sewing Machine and Bicycle Company, Mfrs. Sewing Machines and Bicycles, Akron, Ohio.

PATENTS.

Twenty years continuous practice with the Western Union Telegraph Company, American Bell Telephone Company, General Electric Company, Electrical Accumulator Company, Postal Telegraph-Cable Company, and other electrical companies.

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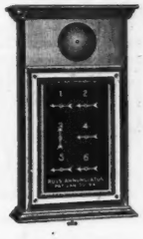

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ENGINEERS, CONTRACTORS,
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EQUITABLE BLDG., BALTIMORE.

SHEAFF & JAASTAD,
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Plans and specifications for and superintendence of Electric Power and Lighting Plants a specialty.

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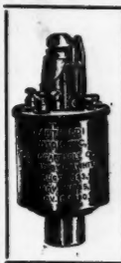

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Smallest, Neatest, Cheapest, Best.

Send for new prices, enclosing business card.

A. L. BOGART CO.
123 Liberty Street, New York.

Manufacturers of . . . Gas Lighting Specialties of all kinds.

"MEN ARE FOUR."

"He who knows not, and knows not he knows not—he is a fool; shun him. He who knows not, and knows he knows not—he is simple; teach him. He who knows, and knows not he knows—he is asleep; wake him. He who knows, and knows he knows—he is wise; follow him."—Arab Proverb.

We know, and we know we know how to build Feed-Water Heaters.

Our Improved Berryman is a "Little Giant," vastly superior to any other Feed-Water Heater both as to results and durability; 18 years as sellers and manufacturers is the price we paid for our experience.

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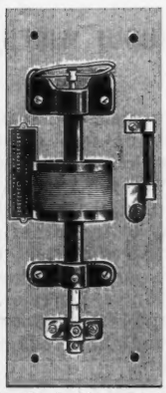

Station Arrester, 2000 V. A. C.

Less than $\frac{1}{10}$ of one Per Cent

of all the Lightning Arresters that we sold last year were returned for repairs, although we repair without charge any proving defective within one year of purchase. Is there any other make that you know of that will give these results?

Garton Lightning Arresters

are the only ones we know of, and our observations are pretty general.

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GARTON-DANIELS COMPANY,
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GET OUR NEW CATALOGUE.

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CREOSOTED WOOD CONDUITS

WILL LAST FOREVER. EASILY ACCESSIBLE. **FOR UNDERGROUND WIRES.** DO NOT GATHER MOISTURE. DO NOT SCRATCH CABLES.

THE MICHIGAN PIPE CO.,
208 N. Madison St., BAY CITY, MICH.

A National Rider never changes his mount.—National Cycle Mfg. Co., Bay City, Mich.

PATENTS.

(*Concluded from page 51.*)

649,069 Supervisory signal for telephone-lines; F. R. McBerty, Evanston, Ill.

649,076 Supervisory signal for telephone-switchboards; C. E. Scribner Chicago, Ill.

649,077 Station appliance for telephone toll lines; C. E. Scribner, Chicago, Ill.

649,078 Signal for telephone trunk-lines. C. E. Scribner, Chicago, Ill

649,086 Electro-magnetic coil; Richard Varley, Jersey City, N. J.—An electro-magnetic coil composed of a series of coil-sections arranged end to end, with intervening air-spaces, and a core therefor, consisting of a tube of insulating material fixed in a position against the interior of said coils.

649,087 Combination lock; C. G. Wade, Chicago, Ill.

649,102 Telegraphic-receiving instrument; N. Flechtenmacher, Bucharest, Roumania—Comprises an armature consisting of a light, freely-movable bar, an electro-magnet arranged to attract said bar, magnetic means for retracting it and stops for limiting its movement.

649,105 Apparatus for electric lighting; O. P. Loomis, Depew, N. Y.

649,138 Electromechanical type-writing system of intercommunication; A. D. Neal & H. F. Eaton, Boston, Mass.

649,151 Apparatus for extracting metals from refractory ores; William Wright, New York, N. Y.

649,179 Transformer secondary; A. F. Rietzel, Lynn, Mass.—Consists of a rigid structure, forming the major portion of the coils or turns thereof, and flexible bars secured to the ends of said turns

649,182 Apparatus for producing radiation and light by electricity; C. H. Stearn, London, England.

(*Concluded on page 53.*)

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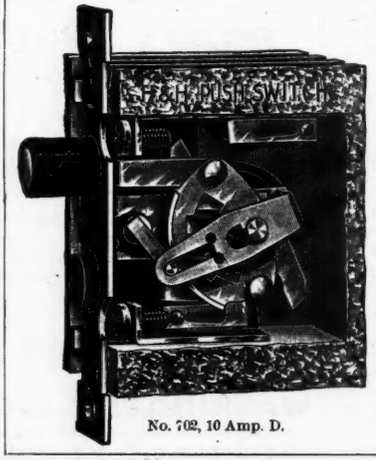

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